

MANAGEMENT, TECHNOLOGY, AND STRATEGY
FOR OFFICE PRODUCTS

INPUT

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Planning Services for Management


MANAGEMENT, TECHNOLOGY, AND STRATEGY FOR OFFICE PRODUCTS

ABSTRACT

This report is an analysis of the strategic opportunities open to vendors of service to the office products environment, including: word processors, personal computers, integrated workstations, facsimile devices, copiers, and PBX equipment.

The tactical and strategic options are described along with an analysis of the technologies emerging in the marketplace today. In particular, service delivery mechanisms, the service management concept, and third-party maintenance opportunities are examined.

This report contains 118 pages, including 22 exhibits.



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AND STRATEGY
FOR OFFICE PRODUCTS

DECEMBER 1983

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I INTRODUCTION

I INTRODUCTION

- This document is intended to examine the issues involved in the technology and management of service for office automation products. It covers the following products:
 - Copiers.
 - Word processors.
 - Workstations.
 - Facsimile machines.
 - PBX/PABX.
 - Personal computers.
- Most of INPUT's reports are based on a specific set of interviews, but this report consolidates the findings of all of the research done on office automation in the 1983 Field Service Program.

A. SCOPE

- This report concentrates on tactical and strategic conclusions and recommendations for office automation product vendors in regard to the technology trends, the service trends, and the challenges facing them.
- Where possible, references are made to market sizes, growth rates, and specific vendor products and service approaches. For the most part, however, the report focuses on the expected evolution of the office products environment in the next five years, and how this evolution will affect the service organizations of participating vendors.

B. METHODOLOGY

- While interviews with users and vendors of office products were the basis of the trends highlighted, much of the information presented is based on extensive secondary research of available public information, supplemented by INPUT's conclusions about the marketplace as a whole. The goal is to provoke new vendors to rethink and evaluate their service approaches and their plans for the future.
- As always, comments and queries from clients are welcomed.

II EXECUTIVE SUMMARY

II EXECUTIVE SUMMARY

A. INTRODUCTION

- This Executive Summary is designed to help the busy reader quickly review the research findings of this report without having to read each section, while ensuring that the key points are not missed. Each main point is summarized as an exhibit, and an accompanying script is given on the facing page.
- INPUT believes that, while the major participants in the coming office automation battle are already in place, the market is for office equipment, not true office automation. Therefore, while the component parts of the office of the future are beginning to emerge, it would be premature to assume that office automation systems (which depend on a degree of integration not yet available from any manufacturer) constitute a meaningful market as yet.
- The significance of this coming integration of function, information, and office equipment for field service organizations is profound, since it presents service challenges that few vendors are prepared for.

B. THE MULTIFACETED OFFICE EQUIPMENT SERVICE MARKET

- Service organizations are increasingly taking on the role of site management, a subset of account control. This suggests that it will soon be important for vendors to provide service for all key products at their clients' sites.
- This total-service approach is particularly important for office automation, where it will be very difficult for customers to isolate one system component (e.g., an intelligent copier) from another (e.g., the network connecting the copier with other parts of the office system), particularly if each component is serviced by a different vendor. This is equivalent to having a system's hardware maintenance and software maintenance done by separate groups, which today's service organizations are striving to eliminate.
- To avoid finger pointing in the office automation service environment, own-manufacture and foreign product servicing must come under a single-umbrella service contract - single-source maintenance or service management contracts. This may involve substantial amounts of service brokering (i.e., subcontracting the actual service of a unit to another service supplier).
- Very few vendor service organizations are set up to sell, administer, or provide this kind of umbrella service contract, and many of them have no clear picture of which office automation units are strategically important to their particular market and which are not. It is vital that this be determined without delay because, even though full office automation is still several years away, the lead time in establishing a service strategy and an organization, and training a service force is almost as long.

OFFICE EQUIPMENT MARKET

- **Narrow, Single-Function Markets with Varying Technologies.**
- **Multiplicity of Vendors, Products:**
 - **440 Office Equipment Vendors**
 - **1,700 Product Models**
 - **Over 20 Million Units Installed**
- **Importance of Single-Source Maintenance, Service Management, and Third-Party Maintenance (TPM) Will Increase**

C. TWO CLASSES OF OFFICE AUTOMATION USERS

- Two classes of office automation users will emerge, and they will have different levels of sophistication and service requirements.
- The Phase 1 User will only need integration at the office level where sharing and flow of information travels over a local-area network that is not connected to an outside network. The smaller users will not usually have great technical sophistication or large staffs to manage the equipment, and will prefer to have a convenient single source of maintenance.
- This first-phase user will also tend to select a single vendor as supplier for a given class of equipment: copiers, word processors, typewriters, etc. The integration required will be simple but will vary from one user to the next.
- The Phase 2 User will tend to be larger companies with multiple centers of purchase decisions. This will translate into multiple vendors sourcing each class of equipment, making the integration function (even at the local office level) a difficult one. In addition, however, a second level of integration will be required, linking separate office locations with each other via a remote network.
- The service requirements of these users will also vary:
 - The larger user will demand more system availability from the total system as well as from each single location. The single-source maintenance contract will be correspondingly more difficult to sell.
 - The smaller user will be easily convinced of the need for a single source of maintenance and will be more easily satisfied with system availability.

TWO CLASSES OF OFFICE AUTOMATION USERS

PHASE 1 USER:

- Standalone Offices**
- Single Vendor by Type of Equipment**
- Integration at One Location**
- No Outside Network Connections**

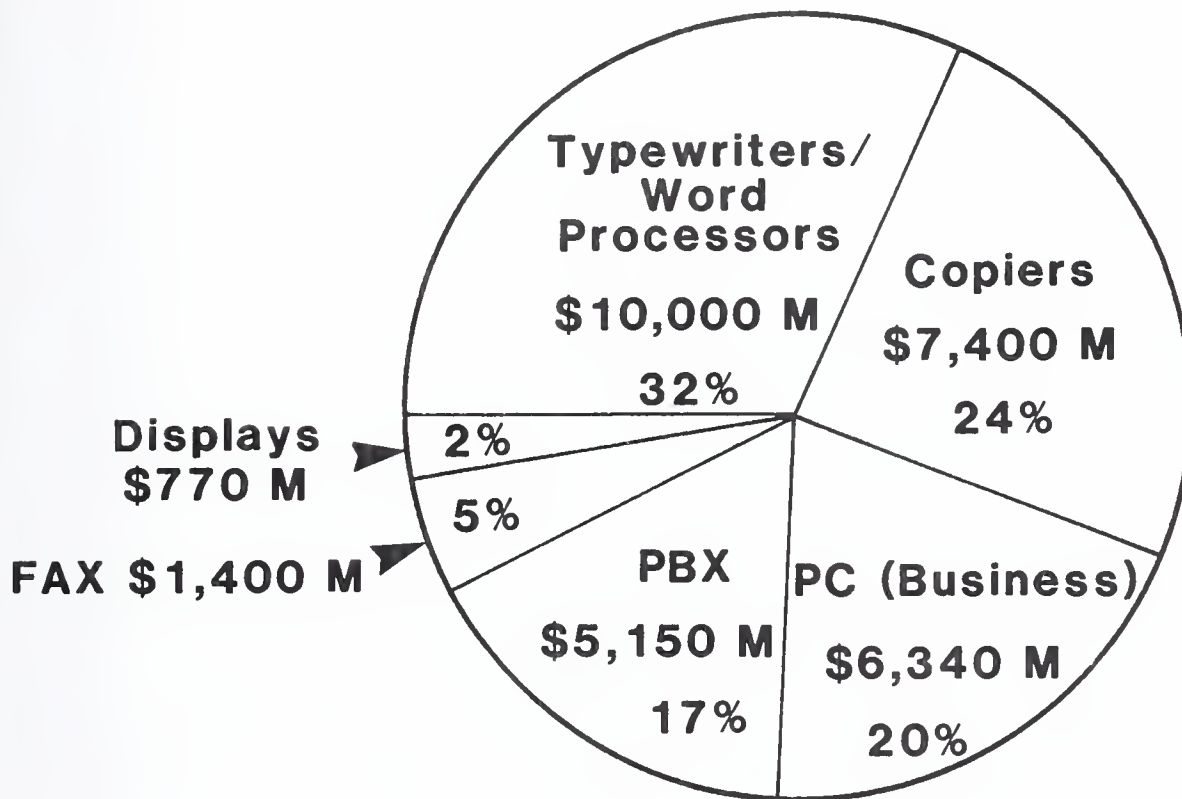
PHASE 2 USER:

- Many Geographically Separate Offices with Similar Functions**
- Multiple Vendors by Type of Equipment**
- Integration at Office Level and at Corporate Level**
- Remote Network Connection**

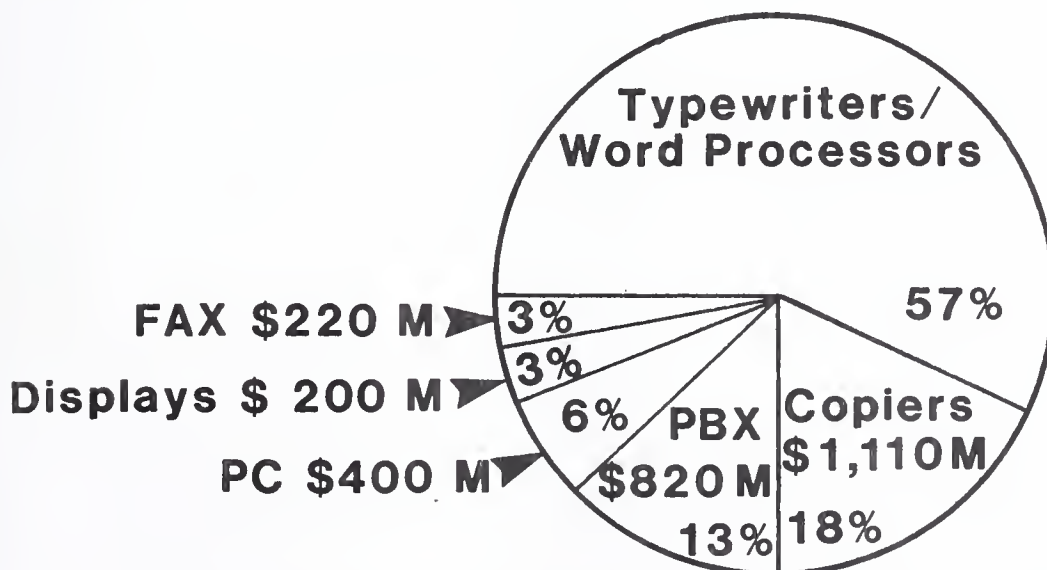
D. PRINCIPAL OFFICE AUTOMATION SERVICE MARKETS

- In the office automation market of 1990, the service challenges are clear:
 - Service of multiple-vendor equipment (or at least service management of same through single-source contract).
 - Integration of different service requirements (equipment side) into a single-system performance (user side).
 - Local area network expertise, both hardware and software.
 - Site management, account control through service.
 - Ability to compete with other vendors for the above.
- The principal markets, in terms of size of the service revenue, to be targeted are, in order of priority:
 - The text-handling market (typewriters, word processors), where the equipment mix is one of older technology with new, micro/mini-based products, and where single stations are freely mixed with multistation systems.
 - The copier market, where intelligent (or communications-oriented) copiers are expected to make their appearance before the dawning of the 1990s.
- These challenges for service organizations call for planning, organizational, and training steps to be taken now, if they are to be met. The lead time to accomplish the necessary changes is at least five years.

PRINCIPAL OFFICE AUTOMATION SERVICE MARKETS



1987 U.S. SALES OF OFFICE PRODUCTS: \$31,060 MILLION



**TOTAL 1987 OFFICE AUTOMATION
SERVICE MARKET: \$6,330 MILLION**

III TECHNOLOGY AND PRODUCTS

III TECHNOLOGY AND PRODUCTS

A. TRENDS IN OFFICE AUTOMATION AND PRODUCT CATEGORIES

- Office automation products are generally considered to include:
 - Personal computers.
 - Standalone and integrated workstations and systems.
 - Standalone and integrated word processing systems.
 - Facsimile devices.
 - Copiers.
 - PBX, PABX, and other interconnect telecommunications equipment.
- The U.S. market in this area is large (over \$13 billion in 1983) and growing, as shown in Exhibit III-1.
- In general, office automation products are undergoing a substantial revolution as a result of:

EXHIBIT III-1

ESTIMATED U.S. SALES OF OFFICE PRODUCTS
(\$ Millions)

PRODUCT	YEAR				
	1981	1982	1983	1984	1985
PBX/PABX	\$2,600	\$ 3,000	\$ 3,300	\$ 3,700	\$ 4,100
Copiers	3,400	4,000	4,500	5,000	5,940
Word Processing Systems/ Workstations	1,700	2,000	2,600	3,100	3,800
Facsimile Machines	100	300	500	800	1,000
Personal Computers (Business Use)	1,200	1,800	2,900	3,800	5,600
TOTAL	\$9,000	\$11,100	\$13,800	\$16,400	\$20,440

- Blurring of functional lines and capabilities between products and systems.
 - Significant increase in competition and price erosion.
 - Trends toward integration via networks.
- There are more than 440 vendors of office automation products and systems in the US today, with over 1,700 products and models, as shown in Exhibit III-2. Each of the major product categories is outlined below.
 - While office automation product markets, such as telephone switches (key systems and PBXs), personal computers, copiers, word processors, and automated typewriters have been developed separately, today they are slowly merging through improved, efficient communications networks such as very high speed Local-Area Networks (LANs) to the extent that, by the late 1980s, the computer, typewriter, telephone, and copier will all be part of one system tied to a network.
 - At the base of new office automation development is the objective of producing a composite document record data base and information access system forged from the blending of text, data, and image streams with voice annotation. Such systems also provide electronic mail delivery, communications to hosts and other data bases, information retrieval, and personal processing support.
 - Behind this general objective are a number of key driving forces:
 - The base technology has driven both the price and the physical size of devices down to where a usable system can easily be put on standard office desks and equipped for multiple tasks.

EXHIBIT III-2

OFFICE AUTOMATION AND INTERCONNECT EQUIPMENT

TYPE OF EQUIPMENT	NUMBER OF VENDORS	NUMBER OF MODELS	INSTALLED BASE	
			1982	1986 (Forecast)
Word Processors	45	175	1,000,000	2,600,000
Electronic Type-writers	20	70	550,000	2,700,000
Desktop and Personal Computers (For Office Use)	165	285	1,900,000	14,100,000
Copying Equipment	34	180	2,100,000	4,800,000
Computer Terminals	110	635	9,400,000	20,100,000
Other Office Automation Equipment (Facsimile, etc.)	70	370	3,250,000	8,400,000
TOTALS	444	1,715	18,200,000	52,700,000

- The manager has become oriented to the technology and is willing to accept it as part of the office environment.
 - Software has been developed that is increasingly user friendly and can be used even by the untrained.
 - Awareness of the value and use of information as part of the daily managerial decision process has increased.
- In essence, office equipment has been accepted as a means to automating office functions and improving productivity but not yet as a fully integrated system supporting the business environment.
- Control of office automation expenditures by the Management Information System (MIS) function is eroding. In the 1970s over 80% of all expenditures were controlled by the MIS directors; in 1982, less than 35% of total company equipment and services expenditures were controlled by MIS.
 - End users are gaining control over their equipment. In 1981 fewer than four million keyboards were tied into central computer facilities. By 1986 over 20 million keyboards will be in the hands of users, most of which will not be under the control of the data processing department.

B. THE OFFICE OF TODAY

- Today's office is marked by a gradual movement to break down barriers between technological "haves" and "have-nots" and to distribute data processing and word processing equipment throughout the office workforce. It is also marked by an explosion in other technologies, all of which are being interconnected through telecommunications.

- It is difficult to be precise in identifying all of these technologies (and today's list could become quickly outdated by tomorrow's announcements); however, a few examples will illustrate current technology trends.
- Information in offices is communicated in writing and by word of mouth. The most common communications media are correspondence, printed material, face-to-face meetings, and telephone conversations. Each of these activities is being affected by new technologies.
- Electronic mail has become a generic term to describe various technologies whose purpose is to share and speed up the movement of written material. Examples include high-speed facsimile equipment, which transmits the image of documents already created; communicating word processors, through which letters are typed in one location and printed in final form in another; electronic message systems, where messages are moved from screen to screen over timesharing networks and other telecommunications networks; and, ultimately, electronic correspondence systems in which letters are transcribed, transmitted, responded to, filed, and retrieved without ever being transferred to paper.
- Similarly, information recorded electronically can be reformatted as desired and transmitted to photocomposition equipment for ultimate conversion to printed matter. For oral communications, audio and video equipment are being used to facilitate teleconferencing (meetings where participants are in separate locations).
- Telephone use is being augmented through the use of voice message systems and the integration of storage and computer capabilities into a single executive workstation.
- Traditional technologies like micrographics are being modernized through interfaces with computers, word processors, and other electronic equipment.

The wave of technology is affecting every medium used in the office for storing information - paper, filing cabinets, books of account, magnetic media, microfilm and, ultimately, the procedures for handling information flow.

- Although machine capabilities, capacities, and methods of operation vary, advanced office technologies have several characteristics in common:
 - They are all telecommunications-based and therefore not only process information but transfer and store it.
 - It is difficult to distinguish separate technologies; instead, with data processing equipment taking on word processing capabilities and vice versa, optical character recognition (OCR) being added to word processors, and a combination of telecommunications and computers being used to facilitate voice messaging, traditional machine distinctions are blurring.
 - They are all moving inexorably toward higher and higher levels of integration in which networks of machines (interconnected through telecommunications) are used to obtain, process, and communicate information and to manage the media used to store that information, whether it is in the form of data, text, image, or voice.
 - They require a lower and lower level of computer literacy for interfacing with the user (which translates into higher and higher overhead in the logic, software or hardware, that accomplishes the functions).

C. THE OFFICE OF THE FUTURE

- This network concept is the key to understanding how advanced office technologies will affect office personnel, both those who are literate in today's technology and those who are not. As time goes on, all the powers of modern office technologies will be available to all office personnel in all work locations.
- No longer will technological power be available only to the computer literate. Instead, every office worker will have at his or her fingertips an increasingly powerful array of capabilities and tools to help improve job performance. These tools will be customized according to the skill level and job content of the individual.
- The implications of the network concept are extremely far reaching. To the traditional technologist (the data processing professional, the word processing specialist) brought up in a single, well-defined technology, the future calls for mastery of not one but a number of technologies, operating under the umbrella of the network. The dominant technology will not be data processing or word processing, but the network. All other technologies will be subordinate to it.
- The office of the future will evolve as a logical extension of today's computing, communications, and office systems technology, but that is where the similarity ends. Through a commitment to enhance and extend the capabilities of man, the organizational, operational, and sociological fabric of the office environment will be changed. Through this merger of related technologies, a wide variety of automation tools will evolve to manage our information, speed up communications, and improve productivity.
- Data processing and office automation activities will be integrated, with both operating over a digital communications network. The familiar office peri-

peripherals will be integrated through digital communications. Media transformation techniques will allow the transfer of information among diverse systems. Voice and graphic data will be digitized and integrated with computer data. Micrographic and video information will be digitized, compressed, and carried along through the same digital communications environment. Each element will be reconstructed at the receiving end and converted to other output media as appropriate.

- The data processing subsystem will employ large host computers with vastly increased processing and storage capacity. Through communications networks, they will be closely coupled to other computers, both internal and external to the company.
- Corporate, national, and international data bases will be involved, with processing taking place in the most convenient location, or even shared among many computer nests.
- Through broadband communications links, dynamic computer load leveling will allow the most cost-effective use of networks of computers, particularly varying workloads resulting from time zone differences. The disastrous effect of a single computer failure will be eliminated.
- Distributed processing, using integrated workstations, will augment these large computers and will extend low-cost computing power to where it is needed while providing the user with transparent access to host computers and other computing and information exchange networks. A true corporate integrated information network will evolve, providing all office locations with large central files, distributed local data bases, and access to large computer resources.
- The automated office subsystem will include advanced word processors, office information systems, graphics terminals, intelligent copiers, digital facsimile, and intelligent phone stations. The man/machine interface will improve

greatly so more people can use computers in their jobs. Friendly computer terminals for information creation and data access will be as common in our offices as typewriters are today.

- Integrated electronic workstations will replace typewriters, supporting document creation, computing, communications, and general office automation. Both graphic and text data will be created on these workstations, and these different types of information will be incorporated into the same document. When required, printed output will be available. Office files will be indexed and retrieved, projects and budgets managed, correspondence and messages logged, and appointment calendars maintained from these stations. Automatic spelling and grammar checking - and even language translation - will be offered through these workstations.
- Voice recognition and control systems will provide totally new ways of controlling this equipment by voice commands. Through voice transcription systems, dictation will have new meaning and far greater use when the spoken word can be processed, directly by a computer, to produce a typed document.
- Electronic mail, initiated from these integrated workstations, will become the primary means of moving internal memoranda and letters, and the cost will be less than postal service. Digitized voice mail will also be available through any telephone and can be distributed directly as voice mail, or affixed to and incorporated in standard documents and electronic mail correspondence. A traveler can have his secretary forward his electronic mail to the nearest office workstation; he can scan the mail at his terminal, listen to voice comments, select critical items, add verbal or typed comments, and send it on to his associates.
- Central office files will be stored in host computers with access from all corporate offices; the backup data will be stored on microfilm and kept in environmentally controlled corporate archives. When information is required, the film will be scanned electronically, digitized, compressed, transmitted and reconstructed on the viewer's screen.

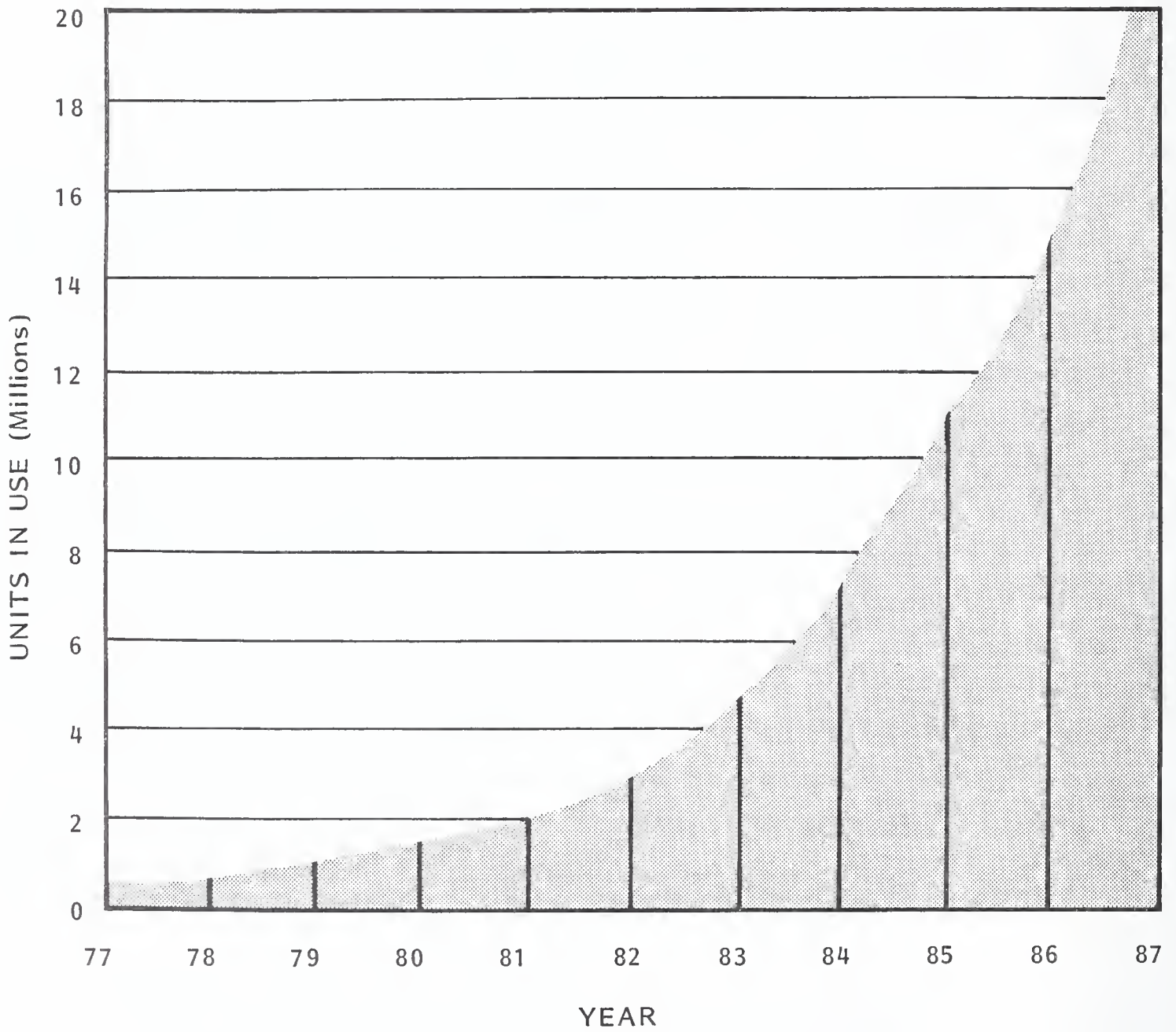
- New laser-based and photo-optic storage devices will hold unimaginable quantities of image and text information. Two-dimensional images will be stored initially. Three-dimensional storage will come about through holography. Corporate data bases will be stored centrally on a single device, with almost instant access.

D. PERSONAL COMPUTER PRODUCT DEVELOPMENT

- Personal computers and microsystems with advanced capabilities are rapidly being developed, implemented, and used. The present and projected growth in the use of PCs, as shown in Exhibit III-3, is an incredible 46% per annum installed unit growth rate.
- New developments in PCs include:
 - Texas Instruments has announced the TI professional computer that runs multiple operating systems, supports graphics and telecommunications to mainframes, and has voice command features.
 - Epson, a leader in dot matrix printers, now provides the QX-10 desktop computer with special graphics and symbol processing.
 - Hewlett-Packard has announced a number of new capabilities, including text formatting and direct screen entry (touch screen control) as well as an expansion of its line of microprocessors and PCs.
 - Nippon Electric Company (NEC) recently extended its 8-bit PC8000 personal computer into a 16-bit advanced personal computer with up to 12 megabytes of hard disk.

EXHIBIT III-3

DESKTOP/PERSONAL COMPUTERS IN U.S. MARKET



- IBM announced both a 370 compatible 3270 PC and, recently, the IBM PC Jr. to provide a full line of PC capabilities with upward compatibility (a feature lacking in many PC lines, Apple in particular).
- In essence, a wide variety of options and alternatives are available to the user, creating a de facto base of office-of-the-future users. The workstations shipped today will need to be integrated via networks in the future. The PC offers a number of advantages:
 - It is individually user controlled and user paced.
 - The user can develop specific programs and files and see the results of a run directly.
 - The user can select and use his own software and applications - the user does not have to wait for a central MIS organization to develop the function.
 - The PC is relatively inexpensive (and will become more so) and can be purchased within the budgetary activity of individual user departments.
- As new second-generation software for PCs becomes available, full functional capabilities such as total management systems (spreadsheet, data base, word processing, graphics, and communications) and standalone capabilities (order processing and inventory control) will be used increasingly.
- Personal-computer-based communications are also developing rapidly. The key is to provide communications to:
 - The outside world.
 - Between personal computer users in different offices.

- Between personal computer users in the same office.
- To and from mainframes.
- Between programs running on the same personal computer.
- LANs aimed at the personal computer market are developing rapidly. If successful, they may compete directly with large-mainframe-based distributed data processing systems.
- There are currently more than 70 vendors of desktop/personal computers, with small startup firms entering the field almost every day.
 - Personal/desktop computers use a variety of 8, 16, and 16/32 bit microprocessors. The Zilog Z80 processor is used in more than a third of the markets offered. Prices are clustered in the \$2,500-\$5,000 range, but this spread will narrow and drop as a result of competition.
- Management of computer systems development and implementation has become increasingly difficult due to:
 - The availability of small computers and PCs that can be purchased locally by the user without approval by the MIS organization.
 - The availability of an increasing array of software packages and products and the development of new methods for software distribution (retail stores, publishing firms, etc.), allowing users to be less dependent on the central MIS organization.
 - Increasing availability of telecommunications and network-based capabilities and functions via the PBX/CBX.

- Shortage of trained, competent software and systems specialists, coupled with the recession-driven cuts in MIS staff budgets, which have stretched MIS department system design and implementation capabilities to the limit.
- Increasing top management attention to large-scale systems development (and projects' cost justification) due to past failures and problems in successful implementation.
- These and other associated factors have caused a loss of control in systems development, implementation, and support by the MIS department and an increasing complexity of options and alternatives available to the end user with respect to data processing, office automation, and telecommunications. In fact, less than five years ago 95% of all computer shipments by dollar value were authorized by the MIS department; today less than 65% are.
- In partial response to this trend, MIS organizations are beginning to increase their end-user orientation by standardization of PC equipment and integration of MIS and telecommunications staff at the corporate level.

E. WORD PROCESSING SYSTEMS

- Word processing systems include a variety of specific products, including:
 - Standalone word processing text editors.
 - Multiterminal shared-word processing systems.
 - Electric and electronic typewriters.
 - Dictation equipment.

- OCR equipment.
- Photo composing entry/edit devices.
- Photo typesetting output devices.
- While at the beginning of the 1980s most of the word processing was done on electric and electronic typewriters, the current trend is toward multistation word processing systems and the use of computer-based technology for word and text processing.
- Word processing is being affected by:
 - The introduction of personal computers into the office environment, providing an alternate means for word processing and text editing.
 - Increased emphasis on fully integrated systems via communications networks.
 - Competition from fully integrated voice/data PBXs, which provide full office automation, including word processing, dictation, electronic mail, store and forward capabilities, etc.

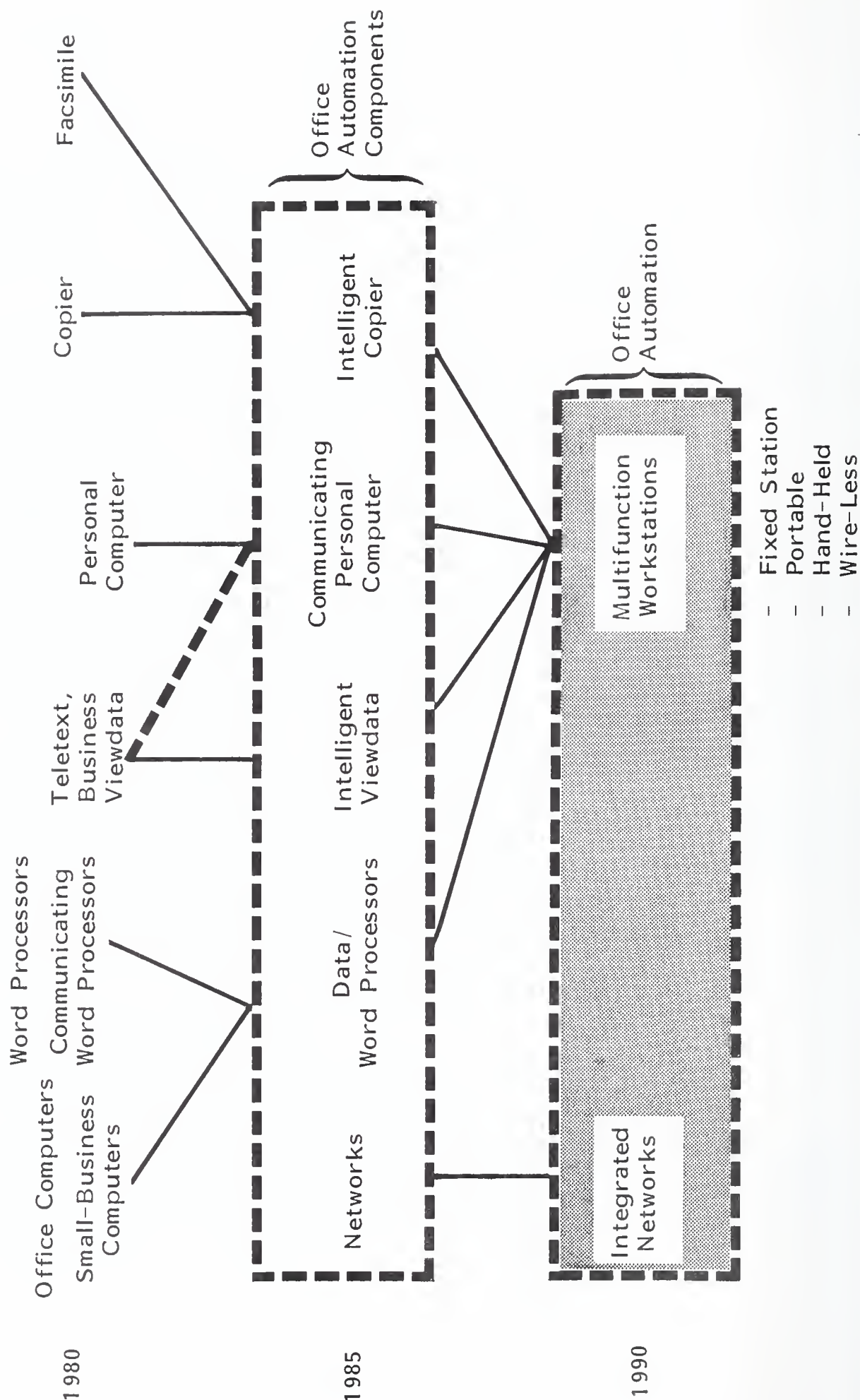
F. INTEGRATED WORKSTATIONS

- Most of the large data processing companies - like Data General, Digital Equipment, Hewlett-Packard, IBM, Harris, and Prime - are building integrated-workstation-based systems with 16- and 32-bit computers as the foundation.

- X.25-based networking products are at the next level; Codasyl-compliant data base management is above that; still higher is ANSI-standard programming languages with productivity aids.
- Products at all these levels must work together, using the same files and data bases and communicating via compatible protocols. The general trend in the development of integrated workstations, shown in Exhibit III-4, is toward full integration.
- The new wave of workstations can be categorized according to the following hierarchy, conforming generally to the three levels of office functions:
 - Single function (dedicated) - stations with significant customization and specialization to perform a single task or group of tasks by a given type of individual (e.g., word processing by secretarial staff, message entering/dispatching, data analysis and forecasting by market planning, etc.). These units will tend to be assigned to individuals and will require low amounts of storage and processing power.
 - Multifunction - capable of performing a menu of unrelated functions such as letter/report formatting and storage, calculator functions, accessing specialist data bases (both corporate and external), and manipulating and storing subsets thereof. These units will require significant amounts of storage and processing power (which can be shared among multiple local units).
 - Managerial - designed to improve the productivity and monitoring of managers, these multifunction, integrated-services (i.e., data, voice) workstations will allow users to retrieve and review documents from a data base and monitor electronic mail traffic for content and volume. This will assist the manager in following the activities of his direct reports.

EXHIBIT III-4

WORKSTATION INTEGRATION: INFORMATION INTEGRATION, FUNCTIONAL INTEGRATION



- To support the necessary functions, a system solution requires intelligent processors at each nodal point in a network or internodal processing - so that the right information is transmitted at the right time to the people who will make a particular decision.
 - Workstation trends will lead to the integration of information functions, as well as of services. Fueled by advances in communications, the multifunctional workstation will take care of local copying, word processing, graphics editing, and text/graphics combinations. In the future, digital channels will be capable of simultaneously transmitting speech, text, and graphics.
 - The common data highway (and also common protocol/interface) needed to tie together information systems is data and telecommunications network integration. Data bases that are more textual than those currently used, virtual terminals with protocol converters, and digital gateways will pave the way.
- The workstations themselves will likely have a high-resolution display, keyboard, memory, mass-storage subsystems, and I/O ports. Fully integrated workstations should provide for the storage, retrieval, and transfer of all forms of data, text, voice, and video information.
- Individual workstations will frequently be connected to a dedicated processor that will control such shared resources as disks, printers, and plotters, while serving as the file manager for all workstations. The workstations also may be hooked up into local-area networks so that all office workers will have access to the resources - not unlike the availability of telephones today. Each station would then become the primary appliance for the information worker - providing data processing, word processing, communications, and other job-support functions.

- The present distinction between word processing and data processing user station systems is primarily in the application software and data base structure. That is likely to disappear in the future office with data base file structures combining text and data processing in a single multipurpose system. Small versions of this kind of system will soon speak the protocol language of local-area networks, either by board or IC implementation.
- More immediately, however, memory expansion, printer interfaces, and shared resources will be more common in word processing systems. For example, the Wordpak II from CPT Corporation (Minneapolis, MN) allows up to eight word processors to access 24,000 pages of information directly. The company's 8000 and 6000 word processors now feature an interface that allows an IBM 75 electronic typewriter to be used as a printer. The typewriter can be used for the rough draft, can be optically scanned for entry into the word processor and then stored, and the document can be retrieved from a disk file for final drafting on the word processor.
- Workstation/terminals that incorporate the ANSI X3.64 specification for data interchange will likely be used in many data communications networks. Loaded with intelligent terminal software, these terminals allow communications on an interrupt basis with both a host computer and auxiliary devices, like printers. Furthermore, the keyboard is also interrupt-driven, so that software stored in ROM can manage all data streams simultaneously.
- Distributed data processing is one attractive option for single-site workstations. In a standalone mode, the terminal user will sign on to a program located in the controller, which is the connection to the host in a distributed system, without any requests for data going to the host. For those offices with very small processing requirements, terminals can be installed and connected to a controller in another location. Because the distributed data processing system can reduce the number of transactions with the host, communications lines and costs should be less as well.

- Another aspect of workstations that will see important development is local storage, which will grow as disk designers continue to put more capacity in smaller packages. One 5.25 inch Winchester disk drive, for example, now offers a 35-megabyte capacity. However, future activity will focus on reducing the package sizes of floppy-disk, minifloppy disk, and .25 inch streaming tape drives. Despite that, .125 inch streaming tape drives are likely to find their way into local storage, as size will be a critical factor.
- In addition, drives continue to be complemented by controllers with error checking and correction and higher density format-encoding techniques. The shift from modified FM (MFM) encoding to GCR (group code recording) types, like 2,7 and 1,8 codes, will give workstation designers more address space to store programs and to update operating systems on a timely basis.
- Intelligent disk drives and drive interfaces will be welcomed as more software and system designers start to attack the file management problem of indexing data and text. Intelligent indexing is the major step needed to cross the human-machine bridge; English-like languages will take file management across to the other side.
- Speech recognition specialists say that the industry can expect to have computer workstations with speech recognition as optional equipment by next year. With data entered by voice instead of by keyboard, not only can infrequent users get closer to personal processing, but also data entry can be more accurate. The keyboard, of course, will be used for data entry for a long time to come, but some special functions will undoubtedly be handed over to speech recognition units. Executives, for example, will be able to call up key confidential information on display screens by speaking code words or phrases. The state of the art is 100 words for speech recognition, but by 1985 the level should reach 1,000 words, which most business applications require.
- Local-area networks, which transfer data and text among locations scattered about a user's premises, are becoming one of the key elements in office auto-

mation. The network will not only enable different types of equipment to share resources, but will also allow local traffic to interface with wide area communications facilities. However, many of today's local networks have been designed simply to replace commonly used point-to-point data connections. As such, they generally do not offer integrated real-time voice capability. In 1984, though, designers will attempt to remedy the deficiency.

- Access to local networks will take as many shapes as users require. Because of the diversity of users' needs, no single product can hope to dominate the market. In addition, a true industry standard has yet to emerge. This lack, however, will encourage manufacturers to produce specialized local networks capable of handling high-speed devices equipped with sophisticated operating systems.
- So far network planners have focused on connecting homogeneous devices, but networks still must be flexible enough to accomodate almost any type of equipment. Because many different units must be able to work together, usually with a variety of incompatible interfaces, network designers have to modify existing software or purchase a variety of protocol conversion devices.

G. FACSIMILE

- Facsimile products can be placed in one of three groups, differentiated by the speed of the facsimile transmission. Group I includes low-speed fax products, which transmit a page of information in four to six minutes. Group II products transmit in two or three minutes, and Group III, high-speed, products transmit less than one minute.
 - Low-speed equipment originally dominated the fax market, but in the past few years advanced automation has made medium-speed equipment more widely available and less expensive.

- There is an increased demand for medium-speed units. In the next few years, the demand should switch from medium- to high-speed units for the same reason.
- Technology for high-speed fax might have been available years ago, but there was no demand.
 - . In the first place, the potential cost of high-speed fax was intimidating. Also, potential users of high-speed, high-volume fax equipment were largely unaware of its existence. Finally, users were discouraged by the lack of Group III standards, a problem that wasn't solved until the late 1970s.
 - . There are several advantages to high-speed fax equipment, besides superior speed. Higher speeds mean lower transmission costs. High-speed fax equipment uses the digital mode of operation, which will enable fax to be integrated with ASCII-code-based electronic message systems. Integrating fax with other capabilities is the key to fax's future. By the 1990s, standalone fax equipment will no longer exist.
- The primary suppliers of facsimile (Quip, Xerox, Graphic Sciences, Rapicom, Tranafax) have all attempted new developments to capture the market:
 - Quip/Exxon is primarily oriented to single-printer workstations with primary focus on the low- and medium-speed units.
 - Xerox has expanded its product line with medium- and high-speed units.
 - Rapicom has the broadest line of high-speed units.

- The future of facsimile as a standalone product is in some doubt, as the integrated office system emerges.
 - Facsimile is becoming less and less important as electronic mail and communications-based word processing systems are developed and used in offices.
 - Facsimile mail will operate over comprehensive digital networks.
 - Standalone batch facsimile terminals will be available at most workstations.
 - Essentially, facsimile is being integrated into the general office network and will, in the future, disappear as a separate standalone product technology except in very small offices.

H. COPYING EQUIPMENT

- Copying equipment is available in a wide range of capabilities and performance:
 - Various speeds.
 - Sizes handled (standard as well as reduction and enlargements).
 - Color/noncolor.
 - Collating capabilities.
 - Types of paper used (plain, coated).

- Types of copiers include:
 - Basic desktop models under \$3,500 - typically handle up to 5,000 copies per month with few frills or special features.
 - Advanced desktop models - typically handle up to 10,000 copies per month with a number of special features. Most units cost \$3,500 to \$8,000.
 - High-volume, free-standing systems - handle 25,000 copies per month and more and have many special features and capabilities.
- A copier used more or less than it is designed to will break down more often than normal. It is therefore important to select a copier to fit specific needs, and copiers should be changed as volume and needs change.
- New copiers are really intelligent printers - new units, particularly the high-volume ones, utilize digital computer capabilities and are linked to word processing and data processing systems.
- There will be continued growth in both high-speed and convenience copiers. INPUT anticipates that the availability of digital networks in companies will accelerate the use of high-speed intelligent copiers.
- Copier design and operation are improving with additions such as:
 - Automatic and semiautomatic feeders.
 - Automatic feeding and stacking of single-sided and double-sided originals.
 - Improvements in toner chemistry to improve copy quality and reduce dependence on operator service.
 - Collators and staplers.

- In the area of convenience copiers, a very important development is the continuing decline in price coupled with an increase in basic features in the plain paper copier market. While the technology in the copier marketplace has been maturing, refinements in manufacturing technology allow manufacturers to provide a state-of-the-art list of features in low-end and mid-range machines that are designed to take on the accessories of high-end units as well.
- The most important developments in the copier field came from the rapid advances in speed and reliability, followed by an unprecedented downward price pressure on plain-paper convenience copiers. Today, a good-quality plain-paper copier is easily afforded even by one-person offices.
- In the copying field, especially for the medium- to large-size user, there is an increasing trend toward integration of copying equipment into the full office automation network.
- Another question to consider is what level of support is needed by each subset of the copier market. The features of economy and convenience dictate the resolution of this issue: copiers can be either centralized or decentralized. This policy is affected by:
 - Large, centralized machines with many capabilities, but requiring queuing time on the part of the users.
 - Small copier systems with fewer capabilities that improve convenience and queuing time.
- The trend is toward centralization within corporations, particularly on a floor-by-floor basis.

I. PBX EQUIPMENT

- The PBX market is beginning to grow rapidly for many reasons. In 1979-1980, AT&T initiated a migration strategy through a pricing policy aimed at convincing existing customers to replace their older PBXs and equipment with new equipment.
- This strategy was effective: PBXs are being turned over (upgraded) at over 30% per year. The AT&T Centrex and announced Dimension product lines were designed to take advantage of this turn. Other vendors such as Rolm, Mitel, and Northern Telecom have also become very aggressive, however, and have captured some of this market share.
- This was particularly true with respect to the Centrex, which is no longer cost or performance competitive with newer technology switches. In essence, the rapidly expanding functional capabilities of the PBX, combined with the breakup of AT&T and the effect of AT&T's past migration strategy, will lead to rapid growth in new PBX sales from 1983 to 1986.
- The creation of the seven new Regional Bell Operating Companies (RBOCs) will further encourage growth and changes as the RBOCs compete aggressively with ATTIS for market users and non-Western Electric products.
- Until recently the PBX, or private branch exchange, served only to switch voice traffic. However, newly developed PBXs can switch voice and data simultaneously, making it practical to use them as local switches for slow- to medium-speed (less than 56Kbps) data devices. In some cases, today's PBXs were designed with this ability, while in others it is achieved by means of hardware and software additions to what had been a voice switch.
- PBXs are able to handle more and more voice and data traffic simultaneously, and the number of users of such dual-personality switches is certain to

expand. In fact, for some market segments, the PBX is viewed as the hub of the office communications network.

- One reason is the predominantly local nature of business communications, both voice and data. About 60% of an organization's communications take place within one building or campus, and another 22% go no further than 50 miles.
- Additionally, the trend in communications is away from analog and toward digital. Some 50% of short-haul calls handled by Bell go digital over the so-called T1 lines, and some all-digital trunks are being made available to the public. Although the voice is an analog signal, there are advantages to converting it to a digital form for transmission, then reconverting it to analog form at the listener's end.
- Recognizing these factors, PBX makers are developing gateways to various external communications facilities. An X.25 gateway, for example, provides access to public data networks such as Telenet and Tymnet, and others will get to other LANs and even, if required, to a hyperchannel. Access to Bell's T1 all-digital transmission link provides a bandwidth of 1.544 megabits per second that can be divided into a number of channels, but it also provides a way to interface to satellites, to microwave and fiber optics, as well as twisted pair.
- The economics of such a scheme are also attractive since costs of laying coaxial cable are quoted at \$1 to \$4 a foot. That's to be contrasted with the use of existing twisted-pair wiring, which comes free or can be redone at lower cost.
- With the use of one of the newer digital PBXs, of course, all internal communications can remain digital. To get to the outside world, the use of modem pools and the concept of resource sharing can reduce one's initial outlay for hardware. Not to be overlooked is a so-called least-cost routing facility, the ability of a switch to select the cheapest way to get a voice or data signal to its destination in the outside world.

- Just as modems of specified speed can be added to and deleted from a modem pool, there is also a modular growth capability in switches. Users can add voice and data capacities of upwards of 20,000 voice lines. Put a terminal on one of those lines, however, and it tends to stay on that line all day; with some architectures, too many such users would monopolize the switch and diminish its capacity to handle the voice traffic.
- Rolm Corporation has attempted to resolve this problem by dividing the bandwidth of one voice channel and multiplexing a number of data connections onto that one channel. It sets aside 96,000 bits per second (bps) of bandwidth on one voice line and can apportion that to twenty 4,800 bps devices, for example, or ten 9,600 bps devices or five 19.2 bps devices. In its so-called submultiplexing scheme, it can also allow 56Kbps devices to share the equivalent of three voice connections. Other vendors take different approaches.
- PBX makers claim more success with the issue of reliability than computer systems makers have had. They say users seem willing to accept a computer going down for a couple of hours now and then, recognizing that there is downtime associated with such hardware. However, a phone system is usually the lifeline of a business, and consequently has to deliver uptime on the order of 99.9%. PBX makers claim this kind of availability.
- To achieve this, of course, vendors have had recourse to extensive redundancy and, in larger systems, to distributed processing - the ability to link PBX nodes that provides more than one path from one node to another. Such an architecture also facilitates the expansion of capacity as one's needs grow.
- Network management is also a function provided by PBXs. As the PBX evolved from its use of electromechanical switches to solid-state electronics and then to being computer-based, it also acquired the ability to provide management with valuable information on telephone use. Not only can it tell you who has been calling whom at what time of day and for how long, but it

can also measure traffic along specific routes and warn when capacities are about to be reached. Such usage patterns, which allow for charge-back for services, apply not only to voice but to data traffic and allow a good level of systems administration.

- The computer-based design of modern PBXs, not surprisingly, offers a number of advantages. Moves and changes, for example, are much easier than in electromechanical systems. When someone moves his office, he can take his phone and data device with him; the wiring is already in place. Someone merely goes to the system administrator's console of the PBX and records this change with a simple entry at the keyboard.
- It is argued, then, that the PBX and the circuit-switching function it performs make it suited to handling voice communications. It does, after all, provide good sustained throughput with no delay. In some applications, such as voice store and forward, there also is a place for packet-switching techniques, but even here the PBX and the telephone continue to be the ideal local-level distribution media. Thus there is room for both packet and circuit switching.
- On local terminal-to-computer communications, where the requirement is for low bandwidth and minimal delays, the alternative to the PBX is a coaxial-based, packet-switched medium like Ethernet. Here, there tend to be many devices connected to the system and little tolerance for delays. The traffic tends to be a character at a time, resulting in overhead to be paid when transmitted through a packet/switched medium. A better alternative is the newer, integrated, fully digital PBX, which can support large numbers of devices, produces little delay, and is completely transparent to the user.
- The economics of the situation change, however, when one looks at long-haul communications, where packet switching is more appropriate, even for a terminal-to-computer link. While this continues to be character-at-a-time traffic, the packet assembler and disassembler function in the current X.25 recommendations could serve to mitigate this problem, allowing packets to

handle communications in the outside world and leaving it to something like the PBX to handle the local distribution.

- There may be a place for the PBX, too, in handling the traffic from personal computers, smart terminals, and word processing systems. Here again, packet switching seems applicable in interconnecting such buffered devices. But PBX vendors, with an eye on the growing market, are moving to support transmissions up to 56Kbps, a bandwidth that can be made available without interruption. The appeal again is the low entry cost for those with a modern PBX and the wiring in place. At the same time, there is no denying that the PBX lacks the bandwidth to handle any device operating in a very high burst mode.
- In time, the vendors might develop a better gateway than X.25 to provide access to co-ax LANs like Ethernet or IBM's proposed token ring. To facilitate the reliable exchange of messages, it is thought that a PBX should be made to look like a node or a connection on the other network. This may require that some very friendly level of coexistence be attained between network and PBX vendors.
- Since the capabilities of PABXs, data-switching, port-contention, and cable-based local networks like Ethernet overlap a good deal, a debate has arisen over which will dominate in the flow of office information.
- One possible scenario is that smart PABXs will be used in offices for both telephone voice traffic and facsimile, word processing, electronic mail, and voice store-and-forward applications. Within the same office, an intelligent data switch (port-contention unit) loosely coupled to the PABX will handle most of the computer-to-terminal communications. Both systems will interface with the outside world through the switched telephone network.
- Proponents of the integrated voice and data PABX contend that their system can do just about all of the aforementioned office communication functions. They see their system winning in the future office market.

- It is more likely, however, that each office will take advantage of the best of all available networks for its particular needs. For example, there is no question that cable-based networks are needed for fast computer-to-computer data transfers, and no amount of PABX upgrading is likely to change that fact.
- On the other hand, port-contention systems dedicated to switching only data can prove very beneficial for installations in which most users are computer terminals communicating with one or more mainframe computers. Finally, the economies of voice and data switching over twisted-pair telephone lines with PABXs will likely prove attractive for those offices in which voice traffic is the dominant form of communication and data traffic is not very heavy.

J. INTEGRATED PBX/COMPUTER TRENDS; LOCAL-AREA NETWORKS

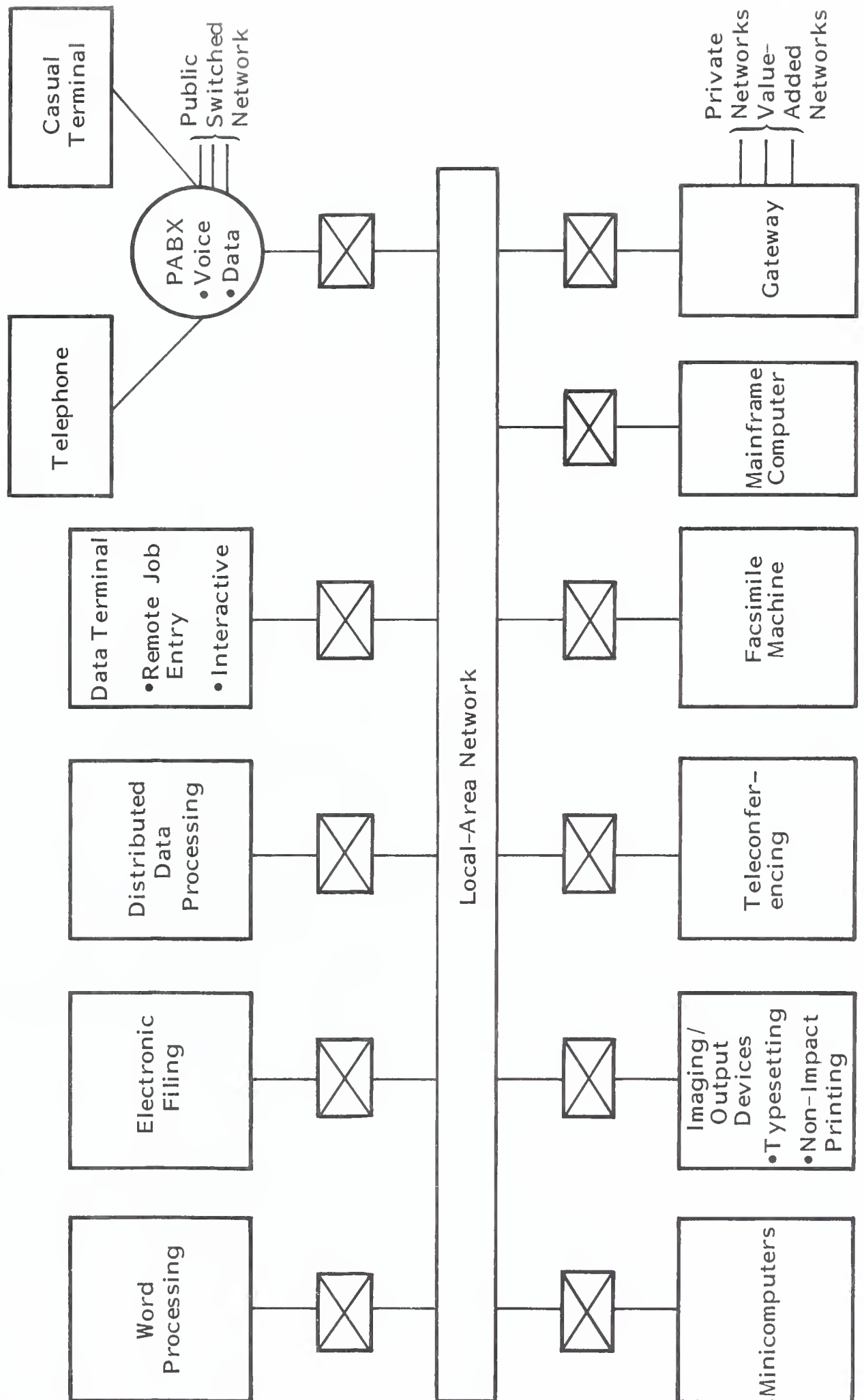
- Some firms are attempting to convince system planners to use minicomputers and PBXs in place of personal computers and local-area networks to generate and receive data in the office. A key argument will be that this combination, though slower than the typical local net, can handle voice communications.
- Thus, designers will have to not only wrestle with decisions on comparative cost and whose equipment to buy, but also with whether or not the speed-power tradeoff is worthwhile. Since the twisted-pair wires of PBXs typically handle 64 kilobits per second versus the 10 megabits of the coaxial cable in local-area networks like Ethernet, the PBX technology seems destined to be shut out when speed is of the essence.
- However, with the minis and PBXs best suited for large numbers of inherently slow terminals and slower workstations, they happen to be positioned in a

segment of the market that is growing rapidly. What is being called appliance users - those who know little about computers - are well served by 64 kilobits per second transmission. In addition, several of the newer digital PBXs, such as the NEC NEAX 2400, incorporate LAN technology.

- A centralized minicomputer or several minis would handle data base access, filing, word processing, electronic mail, decision and administrative support, personal computing, and still other functions - a typical menu.
- Of course these functions are just what local networks and personal computers are supposed to supply to the automated office - but there is that mini-PBX extra of voice handling. If the newcomer's price is right, Ethernet-like and token-passing-based local nets will have to watch their connections. HP is working with a number of exchange manufacturers in its efforts to make PBXs the communication vehicle for its office minicomputers, including Rolm Corporation, InteCom Inc., and Northern Telecom. HP's goal is to make sure its customers can hook up its minis to any PBX without interfacing problems. Like its rivals, though, HP does not expect to make joint sales with the exchange vendors.
- On the bright side, if the major minicomputer manufacturers and branch-exchange makers can agree on industrywide computer-to-PBX interfaces, the end user can only benefit by being able to mix and match exchanges and minis and buy new parts as his needs change, without rendering an entire office automation system obsolete.
- IBM is preparing a local network based on token passing. It already has a line of minicomputers and PBX that has been marketed in Europe (without much success). IBM has developed agreements with PBX firms for interfaces with its minis. It has agreements to use the PBX technology and related large-scale integrated circuits of Mitel Inc. in Ontario, Canada, and has purchased a minority position in Rolm.

- Like other sophisticated computer suppliers, IBM believes that both PBXs and local nets will have a place in the office automation market. It also believes that a minicomputer can act as a gateway between the two architectures. Because IBM has a token-passing local network, is working with several firms on advanced PBX technology, and makes minis, it is logical to conclude that the computer giant will put all the parts together. With a connection to its Systems Network Architecture, it could in one stroke extend its influence from the IBM management information systems departments of its customers, where it is dominant, into their other offices. It is also trying this tack with its personal computer. The firm would also gain by providing and controlling any PBX connection to all its minis used as communication processors and to other front-end machines for IBM mainframes.
- The plans of American Telephone & Telegraph Information System in Morristown, NJ, will have almost as great an impact as IBM's plans. This free-market arm of AT&T has just introduced the System 85, an all-digital PBX that can be connected to ATTIS national communication service, Advanced Information Systems/Net 1000.
- Even more important, ATTIS has a new 32-bit minicomputer, at least one high-end combination of personal computer and workstation using Western Electric Company's Bellmac 32 microprocessor, and the popular Unix operating system. A package of all four of these products would go a long way toward fully automating the office.
- In summary, it is expected that integrated PBX/LAN systems providing the full functions shown in Exhibit III-5 will emerge as the major integration vehicle for office automation equipment.

PBX/LAN CONCEPTS



K. TECHNOLOGY TRENDS AND CHANGES

- General product technology factors affecting the office products market include:
 - Shortening product development and life cycles. New breakthroughs and developments are occurring at an increasing rate. Typically today, products are conceived and brought to market in 12 to 18 months and have a 2-4 year life cycle. By the mid-1980s the development cycle will be reduced to 9-12 months, with potential life cycles of 1-2 years. Thus, a stable image and established market presence is critical to long-term survival and growth.
 - Continuing decrease in product prices. The erosion of product price will continue, particularly in the mass merchandise markets, generated by IBM's aggressive pricing and the entry of major new forces into the market, including the new deregulated ATTIS and the newly formed seven regional Bell Operating Companies.
 - Expansion of niche and segment-oriented marketing and product development. Technology, market, and applications-oriented development will create hundreds of market segments and niches specifically targeted to avoid direct price competition and life cycle impact. Examples include multi-user workstations, hospital information systems, advanced graphics and CAP/RAM, etc.
 - Continue reduction in physical size. Further micro developments are now leading to small, portable products for personal use. These include the recently announced TRS-100 portable, which is the size of a book and weighs less than five pounds.

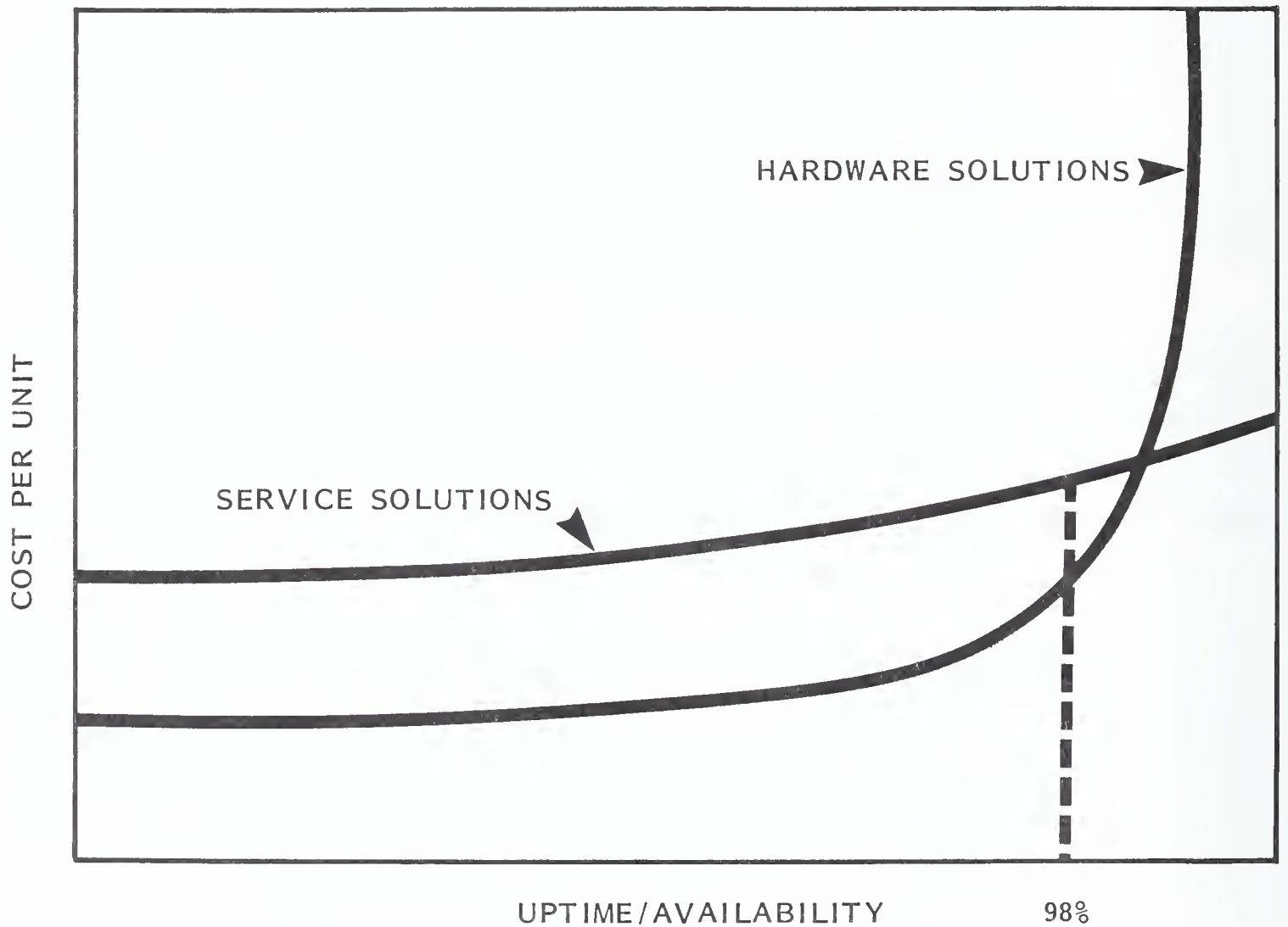
- Increasing reliability and uptime. Fault-tolerant systems and redundancy are increasingly being used to improve uptime and reliability - at a continuously increasing cost however. In essence, a trade-off has to be made by both the product developer and the user as to how much is to be allocated to product cost to improve uptime and reliability, and the ability to improve uptime through the existence of a responsive service organization. Generally, to achieve uptimes of 98% or more, it is less expensive to use the service organization than to build in redundancy and fault tolerance. The trade-off, as shown in Exhibit III-6, must be continually assessed as technology improves. Most users are not willing to pay significantly more for office automation products in order to improve uptime; they prefer to pay less and have a responsible service organization available.

 - Continuing increase in capabilities and features. As microcomputer technology goes from 8- and 16-bit level to 32- and up to 256-bit size, the features and capabilities offered will increase to include voice input for standard commands, direct screen input, and more software processing and applications power.

 - Continuing integration of products and features, through the use of local-area networks and PBX-controlled networks as the communications vehicle. Independent LANs or LANs as part of an integrated voice/data network are increasingly being used to tie individual office automation products together.
- Specific product developments include:
 - I. TECHNICAL DEVELOPMENTS IN PCs
 - New technical developments in PCs include:

EXHIBIT III-6

SERVICE VERSUS EQUIPMENT RELIABILITY
IN ACHIEVING UPTIME/AVAILABILITY



- Local-area networks capable of providing PCs with various levels of communications. The first level, closest to the user, involves a collection of PC machines on a very high bandwidth LAN, where the users form a consortium to share printers, mass storage, and other resources. It is less likely for home use, although a marriage of PC and cable TV or other high-bandwidth home access could occur to provide similar capabilities. High bandwidth in this environment is one characteristic, but the accompanying low delay is also important.
- The second level provides medium-bandwidth services. Again, bandwidth is not as important as delay. PC users typically do not have enormous quantities of data to send, but rather have a modest amount, which they would like to send quickly. A quantity of data might require an hour to send over a 300-baud line, or less than a second over a LAN. Thus the second layer will be driven largely by cost. Users will seek as fast a link as they can afford, not to obtain the raw bandwidth, but rather to obtain the lowest delay for occasional use.
- The second level will be followed by succeeding layers that offer lesser capabilities. For example, while a PC user might be able to easily afford a leased, high-speed telephone circuit or microwave link across town, economics will dictate a lesser capability. This will involve computer-to-computer, not terminal-to-computer communications, requiring reasonably high bandwidth in the 56-K-bits/sec or greater range, to achieve the low delay needed to match the interactive speed of the PC. The messages are composed of short, intermittent transactions, scattered randomly over the entire session between the user and the PC workstation. These transactions are also usually directed to a variety of other computers or servers, not just a single, central system.
- These demands point to a growing need over the next few years for direct connection to packet-switching networks of PCs, workstations, and LANs to increase PC clusters.

- The development of higher capacity total storage at decreasing prices. The cost of hard disk storage is dropping rapidly from today's price of about \$1,500 for a 10-megabyte hard disk drive to less than \$500 by 1985.
- Increase in the array of fully integrated office applications, allowing the user to obtain the full-functional capabilities to support particular office/personal needs.
- The development of advanced techniques for input and output, including voice, screen-tactile, and mouse-type inputs and multi-window screen displays.

2. WORD PROCESSOR TECHNOLOGY

- All word processors have four things in common:
 - A keyboard that, like a typewriter's, has all the usual alphanumeric characters (letters and numbers), plus a number of control keys to edit the text being prepared.
 - A processor unit (based usually on a microprocessor and lots of associated memory chips) that holds all the instructions for carrying out the editing, as well as those for driving other parts of the system.
 - A magnetic memory to store the typed information while it is waiting to be edited. This can be in the form of magnetic cards, cassette tapes, or various sorts of discs (small, so-called floppy discs being the most common).
 - A printer that types out the finished copy and can either be attached to the keyboard or remote in its own cabinet and connected by cable.

- The general trend is away from separate products, such as electric typewriters, and toward integrated systems and products, as shown in Exhibit III-7.
- Memory typewriters are ideal for typing reams of essentially similar documents or letters with only minor changes in text. Once a standard letter has been stored in the memory, all a secretary has to do to generate a version tailored to an individual recipient is change the name and address, and make any other alterations deemed necessary. However, a memory typewriter does not allow a typist to see the final text (and so check whether alterations have been made properly) until the machine automatically prints it out. That makes correction and editing tedious, time-consuming, and expensive.
- A refinement is the thin-window word processor, which has a tiny display panel (like that on an electronic calculator) to show the line of words being typed or corrected.
- New product developments are now taking place using 16- and 32-bit microprocessors to offer more features and capabilities on an integrated basis.
- Advanced word processors, such as Xerox Star, are designed to provide word processing, typesetting, and business computing.
 - Wang laboratories announced the Alliance 250, which incorporates word processing, data processing, image processing, audio processing, and networking.
 - DEC recently announced "Office Plus," a full family of word processing and related capabilities to support office automation, including DECmate, DECword, DECset, DECtype, and DECmail.
 - Honeywell announced its Office Automation System (OAS), providing fully integrated intelligent word and document processing designed to work on a standalone or network-based structure.

EXHIBIT III-7

WORD PROCESSING APPROACHES
(AS A PERCENT OF INSTALLED BASE)

METHOD USED	YEAR	
	1981	1985
Manual and Portable Typewriters	10%	12%*
Electric Typewriters	72	40
Electronic Typewriters and Standalone Word Processor Workstations	1	20
Word Processing System/Multistations	10	9
Mainframe Computer Printers	3	8
Personal Computers	1	5
Small Business Systems	2	5
Timesharing Services	1	1
TOTAL	100%	100%

* Includes Portable Electronic PCs and Typewriters

- There is a continued shift toward fully electronic methods for word processing, text processing, printing, and integration; there is also a shift away from standard electro-mechanical typewriters. New developments in word processing systems integration include:
 - Shared resources, such as storage devices and printers, which all personnel can access from their terminals. Quick access to information enables speedier decisions to be made and increases productivity.
 - Open-ended design that lets the user increase the size and power of the system simply by adding modular equipment to it.
 - Lower cost per workstation than is the case with multiple standalone units.
 - Rapid communications among all the network's participants. Messages are delivered almost instantly.
- Most major electronic office equipment manufacturers are offering clustered word processing systems. These may be shared-logic in nature (that is, individual terminals share the logic of the computer; when the computer goes down, the entire system crashes). Alternatively, terminals may possess their own intelligence that enables them to function independently, even if others in the group are down or working on another program. Although both types of clustered systems are geared primarily toward word processing applications, many also handle various software programs that can be used by managers and operators.
- Recently vendors have been enhancing their products with several new capabilities. These include the following items:

- Functional integration that allows different applications to work together compatibly.
- The ability to integrate dissimilar electronic office devices through local-area networks.

3. ADVANCED COPIER DEVELOPMENTS

- Two new technologies are affecting copier design: laser imaging and optical fiber imaging. These technologies permit creation of printed originals directly from text stored electronically on the word processing or computer system - or transmitted electronically via satellite - without the costly and labor-intensive steps of typesetting, paste-up, and creation of offset plates.
- Growing interest exists in nonimpact distributed printing: generating information at one location (via PCs, etc.) and printing it out at another.
- Several new electronic printing systems/advanced copiers have been announced, including:
 - Xerox 9700 and 5700 systems.
 - IBM 6670 information distribution.
 - AM International Electronic Document Communication System (EDCS).

4. LOCAL-AREA NETWORKS TECHNOLOGY DEVELOPMENTS

- A Local-Area Network (LAN) is a pipe composed of twisted pairs, coaxial cables, optical fiber, or some combination of each. The pipe can make connections for telephone service, hook computers together with other computers, switch voice and/or data at very high speeds, and link rooms together for teleconference. The key issues surrounding local-area networks are: 1)

the sheer amount of cable that needs to be installed, 2) the level of service that is required will determine PBX or LAN or a combination of both, 3) the user application (if all that is needed is 300 bps (bits per second) data with only a few terminals, why bother?), and 4) long-range company strategy - the company's commitment to information systems and how that impacts each of the internal departments.

- Second, there is the issue of increasingly difficult choices in creating networks. With deregulation, there are now over 150 different long-distance telephone companies. In the near future, the user will probably have at least two, probably three, different companies available to connect PBX processing to long-distance telephone calls. American Bell is likely to offer a whole new range of services for the consumer, including data services.
- Third, rapidly changing technology also must be considered. Packet-voice is on the horizon. This technology is presently being used exclusively for data, but cross-country testing has proven the viability of its application for voice.
- New LAN development features include:
 - Call forwarding, conference calling, call transfer, and many other features like speed dialing.
 - Voice store/forward, which involves a centralized telephone answering system but with sophisticated features such as message forwarding.
 - Voice/dictation integrated with voice store/forward or standalone.
- Network features include:
 - Least-cost and optimized network and off/network routing of calls.
 - Tandem network features for multinode environments.

- Time assignment speech interpolation/vocoder for voice concentration.
- Encryption for security.
- Technical control for echo.
- Communications to and from computers.
- Data features include:
 - Micro/storage pool for shared central processing units and disk.
 - Modem pool to reduce costs.
 - Protocol conversions supports asynchronous and bisynchronous transmission.
 - Speed conversions both upward and downward.
 - Language conversions for various word processing manufacturers.
 - Packet interface provides X.25 to carriers.
 - Management features for private-line monitors, network control functions, backup, and reroute.
- Software features include:
 - Word processing supporting dumb terminals on and off net.
 - Electronic mail for one-to-one communications.

- Computer teleconferencing providing group to group communications as well as personal memo, advanced searching, and status and management reports.
 - Data base management systems for access to the corporate information system for personnel and manufacturing control.
 - Financial modeling/graphics.
 - Decision support systems.
- The PBX of the future will be able to perform a wide range of functions that were inconceivable only a few years ago. The limiting factor will be advanced applications software. Sophisticated computer applications software, such as computer teleconferencing and personal computer software, will be the real issues facing these manufacturers.
 - A new company in Andover, Massachusetts, may have the key to solving the problem of handling slow and high-speed data in one piece of equipment. Ztel Inc. has a 64-kilobit-per-second, private-branch exchange with a built-in 10-megabit/second token-passing-ring local network. Other firms, such as InteCom Inc. of Allen, Texas, are working on the same concept.
 - That a local network can be integrated into a PBX is not news. However, the price of such a net and uncertainties about buyer demand have held up development. Moreover, the manufacturer of such a design combination could not settle on a configuration until a major mainframe computer firm came up with its local-net design, because the two local nets would have to communicate without additional gear to meet cost and efficiency requirements.
 - Ztel appears to have turned out a cost-effective design: installation is listed as \$800 to \$1,000 per line, the same as for plain PBXs. Ztel also feels that

the market window has opened because offices needing both slow and fast data handling are automating at an increased rate. Finally, the firm believes that much of the PBX/local-network connection to computer gear will be to the IBM environment. IBM has indicated it will hook its computers together with a token-passing local network; Ztel maintains that its computers can communicate with the IBM ring directly.

5. PBX TECHNOLOGY DEVELOPMENTS

- PBXs are rapidly shifting to full digital technology and adding full office automation functions through individual workstations. Local-area networking capability (providing high-speed data switch capabilities between computers and terminals) is also being added. Thus the newer PBXs are now offering:
 - Telemanagement and communications control over the network.
 - Integrated voice/data stations and terminals.
 - T-I links to public networks.
 - Speed/code/protocol conversion.
 - EDP bridge and network interchange.
 - Local- and wide-area networking capability.
 - Store and forward.
 - Gateway functions.
 - Wideband interface and control.

- Increasing technological innovation is coming from the primary interconnect vendors such as Western Electric, Northern Telecom, Rolm, Mitel, GTE, NEC, and GTE. However, new entrants such as TIE are also now coming into the market. A full listing of major PBX vendors is shown in Exhibit III-8.
- Marketing and distribution of PBXs is also rapidly changing as a result of deregulation that created the new deregulated ATTIS and the seven new Regional Bell Operating Companies (RBOCs). RBOCs will also be selling PBXs and other CPE through deregulated subsidiaries. While the general PBX market will grow, the greatest rate of growth will occur in the range of 100-1,000 lines. Very large PBXs (1,000-plus lines) will grow, but only the major private networks using PBXs of 5,000 lines or more will grow rapidly. The estimation of PBX installations by user size is shown in Exhibit III-9.
- A modern PABX had these main subsystems: 1) minicomputer with CPU based on microprocessor technology, 2) Random Access Memory (RAM) switching unit, and 3) associated electronics such as tone generators and rotary-to-digit translators. Larger units can include a second minicomputer for backup.
- Typically, a PABX system's costs can be roughly broken down as 1) cabinet hardware and physical frame, 10-15%; 2) power supply, 10-20%; 3) memory (switch), 10-25%, depending on unit size and range of capabilities; 4) attendant console and related circuitry, 2-5%; 5) assembly and test, 5-15%; 6) lines and trunks, 20-30%.
- The ranges in costs are due to system size differences. For example, line, trunk, and power costs tend to be directly proportional to the number of lines served by the PABX. This means that the cost for the line-dependent elements are typically higher in larger systems.
- Among the critical semiconductor components are CPU chips. Originally these cost PABX manufacturers \$125 each. They now cost under \$8. Once a CPU chip required 15-20 associated semiconductor devices. It now requires none and is over 200 times more powerful.

EXHIBIT III-8

MAJOR PBX VENDORS

VENDOR	MAJOR PRODUCTS	TYPES OF SYSTEMS		
		SMALL SYSTEM UP TO 150 LINES	MEDIUM SYSTEM 150-1,000 LINES	LARGE SYSTEM 1,000 LINES +
ATTIS	Prelude, Dimension, Horizon	X	X	X
American Telecom	FOCUS	X	X	X
Anaconda-Erickson	CNC-75D, CNC-450D, MD-110, ASB100, ASB900	X	X	X
Executone/Contel	Enterprise, Echelon, Eclipse, Vista, Summit	X	X	X
GTE Business Communications Systems	GTD 120, GTD 4600, GTE OMNI, XT300	X	X	X
Harris Digital Telephone Systems	Harris 110, D1200	X	X	-
ITT Telecom	3100, SDX 1032	X	X	-
INTECOM	IBX S/40	X	X	X
MITEL	SX-2000, SX-2	X	X	X
NEC Telephones	NEAX 12, NEAX 22, 2400	X	X	X
Northern Telecom	SL-1, SL-10, SL-100, DDMS-250	X	X	X
OKI Electronics	Discovery, Spectrum KC	X	X	X
Rolm	CBX Series	X	X	X
Siemens	Saturn III	X	X	X
Tie/Communications	TCI-7, CX(128)	X	-	-
United Technologies	Senator 200, Executive 400	X	X	X
Z-TEL	PNX	X	X	-

EXHIBIT III-9

PBX SYSTEMS BY LINE SIZE (CURRENT AND FORECASTED)

YEAR	UNDER 100 LINES	100-400	400-1,000	1,000+	TOTAL BASE
1982	105,904	69,852	38,306	11,266	225,328
1983	109,745	72,385	39,695	11,675	233,500
1984	114,915	75,795	41,565	12,225	244,500
1985	119,703	78,953	43,297	12,734	254,687
1986	126,003	83,108	45,576	13,405	268,092
1987	132,635	87,483	47,974	14,110	282,202
1990	154,698	102,035	55,955	16,457	329,145

- The telephone bill of a typical business reveals that about 75% of monthly cost is for use (local and long-distance calling), 20% for equipment, and the balance for maintenance, moves, and changes.
- The cost of moves and changes is reduced by the application of microprocessor technology (software programability). Overall equipment cost, however, remains about the same as in older step or crossbar systems. Microprocessor technology enables the PABX to substantially reduce toll costs through various route-optimization and restriction techniques. These capabilities can reduce overall telephone costs 10-15%.
- With its computerized controls and capabilities, and all-electronic digital switching, the PABX could well be the precursor of the teleprocessing controller for the office of the future. The use of digital-switching techniques means that PABXs are theoretically capable of the full range of digital communications required by most companies - from voice and facsimile to computer-to-computer transmission.
- Software control and increasingly powerful minicomputers give PABXs the flexibility to handle a variety of terminals, including printers and CRT displays that can be included in integrated office telecommunications systems.
- The PABX offers scores of capabilities, including call forwarding (forwarding calls intended for one extension to another extension located elsewhere when someone leaves the area served by the primary extension) and the ability to automatically select the most economical circuit for a toll call.
- PABX capabilities can be grouped into four general categories:
 - Call convenience. This can include functions like camp-on-hold, in which the PABX queues a call attempt to a busy extension until that extension is free, and then completes the call.

- Cost controls. These can include toll restriction, in which the PABX automatically restricts the placement of certain types of local or long-distance calls from selected telephones. Route optimization automatically selects the least-cost route.
 - Network control. This includes the capabilities for the movement of data and voice-based messages, the handling of queues, etc.
 - Reporting. This includes call detail recording that gives comprehensive reports on outgoing calls. This function is particularly useful in matching trunk and station needs to employee productivity. The reporting capability also provides a means of spotting user abuse of the telephone system and of allocating telephone expenses to users on an accurate and equitable basis.
- In summary, most state-of-the-art PABXs provide the same basic capabilities. Some of the more important are:
 - Direct outward dialing (DOD). Telephone users can reach the public telephone network directly without company operator assistance.
 - Direct inward dialing (DID). An outside caller can dial directly to an individual telephone on the PABX system without going through the company operator.
 - Least-cost routing. An outgoing call can be automatically placed over the telephone circuit that is least expensive for that particular call.
 - Call restriction. Certain telephone users can be automatically prevented from placing long-distance calls.

- Speed numbers. The system can automatically dial frequently called seven or ten-digit telephone numbers, with the user being required only to enter three to five digits.
 - Call forwarding. Allows a user to program his/her telephone to be answered by another telephone.
 - Call pickup. User can receive a telephone call ringing on another telephone by picking up his or her phone and entering predefined digits.
 - Conferencing. A user can tie in with a number of other telephones by dialing the proper code.
 - Call waiting. Tone notifies a user engaged in a conversation that another party is attempting to reach him/her.
- The consequences of commercially successful applications of combined voice-data technology will be far-reaching. The requirements of the fully automated office will fundamentally alter the nature of PABX products.
6. IMPACT OF CIRCUIT-LEVEL TECHNOLOGICAL DEVELOPMENTS ON PRODUCT CAPABILITIES AND PERFORMANCE
- Data processing and electronics technology have been continuously affected by improvements in underlying technical developments in semiconductor circuits.
 - In the 1960s semiconductors that were packed at less than 100 per chip made large mainframes economically feasible. However, the systems required a controlled environment and demanded full communications control within the mainframe (between the user and the system).

- Semiconductor content of overall logic circuitry in computers is growing rapidly, as shown in Exhibit III-10.
- By the 1970s the ability to put thousands of gates on a single chip led to the development of the standalone minicomputer, which required fewer environmental restrictions and allowed the distribution of computing capability to local users. Communications was handled via a separately dedicated frontend processor to the mainframe. Processing was still limited, however, by the size of the words (8-16 bit) handled by the chip processors.
- In the 1980s very large scale integration, with circuit densities of hundreds of thousands of gates per chip, and increasing word size (32-plus bits) have already lead to development of the fully standalone microprocessor and the personal computer, which require no specialized environment and provide fully distributed processing resources for individual users on an extremely cost-effective basis, as shown in Exhibit III-11.
- This trend will continue through the remainder of the century, leading to the viewing of data processing as a commodity-like capability. Mainframes will be primarily concerned with data storage and retrieval; they will also handle batch-oriented applications and control the major printing tasks. Communications networks connecting fully distributed microprocessors and PCs to each other and to the large data-base-oriented mainframes will take over the control portion previously provided by the large mainframes.
- In the 1980s communications-based systems for voice and digital network control (PBXs, PABXs, CBXs) have also taken advantage of the VLSI circuit developments, becoming fully digital and providing full functionality for distributed resource processing.

EXHIBIT III-10

USE OF SEMICONDUCTORS IN COMPUTERS

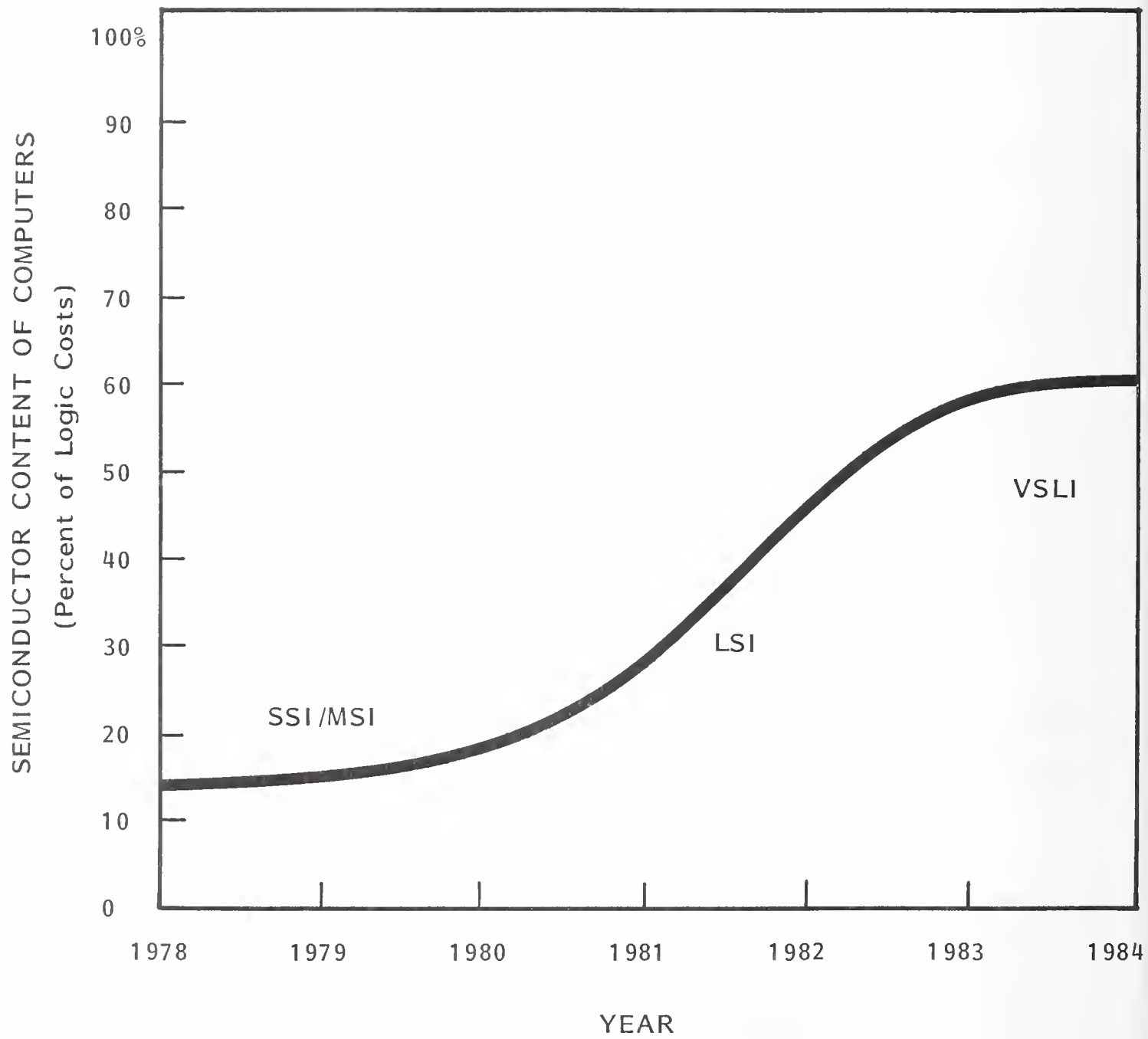


EXHIBIT III-11

IMPACT OF CIRCUIT TECHNOLOGY ON SYSTEMS AND COMMUNICATIONS DESIGN

DECADE	LEVEL OF INTEGRATION	PRIMARY AREA OF SYSTEMS DEVELOPMENT	COMMUNICATIONS ENVIRONMENT
1960s	Discrete Chips – Solid State Integration	Mainframes	Central Processor-Controlled
1970s	MSI, LSI	Miniprocessors	Distributed Data Processing
	VLSI	Microprocessors	Distributed Resource Systems

- Telephone sets/stations are now available to provide both voice and digital processing capabilities.
- Digital networks under interconnect control also provide the ability to link up and convert to PC, micro, mini, and mainframe systems.
- Other technological innovations (including fiber optics, flat screens using Liquid Crystal Display (LCD), and bubble memories for local storage and retrieval random access) have all contributed to:
 - Increasing the availability of functional capabilities at decreasing costs.
 - Blurring the previously clean separation between data processing and communications.
 - Expanding the capabilities available to the individual user.

a. Semiconductor Technology

- The cost of semiconductor logic is expected to represent over 60% of the total logic cost for computers of all types. Although BLSI chips represent an ever-growing percentage of total systems cost as levels of integration continue to grow, the total VLSI logic system cost is expected to peak at 70% because, unlike memory chips, logic chips are not high-volume standard parts.

b. Data Transfer Rates

- What is considered a satisfactory or acceptable transfer rate between a terminal and a host computer is difficult to define, because at the very least it depends on the number of terminals. The issue becomes clouded when interactive systems have to be rated for average or adequate response time, because the number of users working at any given time is not known. Essentially, any rate that slows down the user is unacceptable.

- Currently, end users of CRT terminals agree that 1.2 K-bits/sec is the minimum speed for operating a character-mode terminal while editing. For routine plotting (e.g. business graphics) 9.6 K-bits/sec is usually suitable. More sophisticated block-mode terminals like IBM 3270-type devices are frustrating to use at speeds below 9.6 K-bits/sec and are best operated at 19.2 K-bits/sec or more.
- Generally, file transfers between intelligent devices require data transfer rates of 1 to 10 M-bits/sec. In contrast, fast host-to-host communications work at about 50 M-bits/sec.

C. SELLING, SERVICING, AND SUPPORTING NEW OFFICE AUTOMATION PRODUCTS TECHNOLOGY

I. CHANGES IN DISTRIBUTION

- Distribution of office products is changing rapidly, as shown in Exhibit III-12. While office products were usually sold through direct sales forces or through dealers/distributors or manufacturers' representatives, the new retail and mass merchandise channels have become a major factor. New distribution channels now include:
 - Franchised nationwide and regional retail store chains are becoming major distribution channels. An example is Computerland, which has already opened over 400 stores and has plans for more than 250 new outlets in 1983-1984.
 - Mail order houses.

EXHIBIT III-12

CHANNELS OF DISTRIBUTION FOR OFFICE AUTOMATION PRODUCTS
(PERCENT OF UNITS SOLD - 1982, BY CHANNEL OF DISTRIBUTION)

DISTRIBUTION CHANNELS	EQUIPMENT/HARDWARE							
	Personal Computers	Word Processors	Work-Stations	Facsimile	Copiers	Key System and PBX	Software	Supplies
Retail Stores	40%	25%	15%	5%	3%	2%	30%	25%
Independent Systems Vendor/Distributor	18	30	35	36	15	18	18	10
Local Office Products Dealer	6	4	5	14	28	-	2	40
Direct from Manufacturer	28	38	45	45	47	35	31	17
Mail Order	4	2	-	-	5	-	15	6
Other	4	1	-	-	2	45*	4	2
TOTAL	100%	100%	100%	100%	100%	100%	100%	100%

* Telephone Operating Companies

- Computer mart shopping centers, composed of vendor-specific stores. Boston's BOSCOM, scheduled to open in 1984, is planning to have up to 300 companies with permanent showrooms. A new computer mart is also planned for Dallas in 1984.
- OEM/Systems houses, which add value in terms of hardware and/or software to purchase hardware in quantities and resell to the end-user market in particular market niches and segments.
- Existing major merchandise and general department stores - Sears for example has established business centers within their stores. Other stores and chains have also created computer departments that sell to the home market and to industry.
- Independent retail stores, including stationery and office products stores for distribution of copiers and other office equipment, telephone stores, etc.
- Manufacturer-owned retail stores, including those of IBM, Digital, and Xerox. By the end of 1983, IBM is planning to have approximately 200 IBM product centers. Tandy distributes through a massive distribution chain of over 8,000 Radio Shack outlets.
- Other distribution channels include the existing market mechanisms, such as:
 - Manufacturers' direct sales force.
 - Independent and manufacturer-linked distributors.
- This wide array of new and existing distribution channels is opening up new markets and creating a massive installed base of equipment that must be serviced and supported. It is clear that these distribution mechanisms will affect the future growth and needs of the market. It is, however, important

to understand that these changes are not consistent across all product areas. As shown in Exhibit III-12, the percentage of office automation products sold through different distribution channels differs widely. Retail stores are primarily selling personal computers, software, and to a lesser extent, small word processors.

2. CHANGING USER REQUIREMENTS

- User maintenance requirements for service in support of office products is also changing. In general, there is a significant percentage of users who do not feel that the level of hardware and software maintenance received is satisfactory. On the average, less than 40% of all customers are satisfied with the levels of service received. This is particularly true in the area of personal computers and PBX/PABX equipment.
- In the case of personal computer users, particularly business customers, users are becoming increasingly dependent on their equipment. However, the quality of service is poor, primarily because the retail stores, which are the major distribution channel, have little capability or experience in on-site service and support.
- In the case of PBX/PABXs, users are increasingly dissatisfied with the levels of service being offered. This dissatisfaction is due to the increasing complexity and importance of the PBX (in connection with the integration of all office products) and due to the deterioration in service by AT&T and the Bell Operating Companies.
- There is also growing dissatisfaction with the user documentation being supplied. Again, this is due to the growing complexity of the equipment and to increasing integration. The result is problems that are traceable to the interface between different units.

- Increasing integration and the growing array of features and capabilities changes user dependence on, and therefore requirements for, service and support. This is particularly true for product technologies that are changing most rapidly (personal computers, PBX, and word processing systems).
- User requirements are also affected by growing dependence on their equipment for daily operations. This is reflected in ever-higher user requirements for uptime and repair response. These requirements have increased particularly rapidly for PBX equipment.

3. CHANGING VIEWS OF SERVICE DELIVERY MECHANISMS

- The changing technology and user requirements are, in turn, affecting the user acceptance of, and interest in, alternative service delivery mechanisms. In general, these changes are greatest with respect to personal computers, word processors, and PBXs.
 - Most users are still oriented to the traditional methods of on-site service.
 - Most PC users are willing to provide direct assistance to support the repair process by carrying modules to the repair center, helping to replace boards, etc. However, many of these users (particularly business customers) demand on-site service.
 - There is growing acceptance on the part of users toward involvement with remote diagnostic centers to isolate and/or correct problems.
- User service response and repair times are generally being met, even though the requirements have become stricter.
- The major problem area in personal computers is poor vendor response and repair times. Vendors originally thought that PC users were not highly de-

pendent on their equipment. However, the increasing use of PCs in business has created a new set of requirements that are not now being adequately met.

- While copier and word processing response and repair time requirements have become shorter, the vendor service organizations have generally responded well to these needs.
- However, the shortening repair and response requirements in PBX and facsimile have not been as adequately met.

4. CHANGING REQUIREMENTS FOR SERVICE MANAGEMENT AND SUPPORT

- The most important challenges resulting from the increasing proliferation and integration of office products are the emerging requirements for overall integrated service management. Users are increasingly interested in a single organization that can handle the array of problems generated by the installed base of office automation products supporting their operation. These requirements stem from the need to:
 - Avoid finger pointing - provide a single source of responsibility for service.
 - Provide overall management of service response and repair times.
 - Provide service cost containment.
- As an indication of this emerging requirement, an increasing percentage of users are either currently using, or are considering using, third-party maintenance service organizations. Product areas currently using third-party maintenance to some extent (30% or more) include PBX/PABX, personal computers, and workstations.

- Twenty percent or more of personal computers, word processors, and workstation users are now considering third-party maintenance as an alternative to vendor service.
- Service management contracts, as an alternative, are being considered by PBX, word processor, and workstation users.
- Service management, involving the ability to deliver total service on a controlled basis for a variety of products in the office environment, is being developed as an alternative delivery mechanism by several organizations. There appears to be interest in this concept, particularly on the part of large users with integrated office systems composed of multiple vendor units/products.

5. SUMMARY

- In summary, there are a number of new challenges being created as a result of the technological developments in office automation relative to:
 - Increasing capabilities and functions.
 - Overall integration.
 - Growing dependency on products.
 - Decreasing cost and size.
 - Increasing use of very high speed LAN and integrated voice/data PBXs ties the individual office automation products together in a single network.

- These challenges can be categorized in terms of:
 - Changes in distribution, creating the need to provide service for products sold through new mass merchandising and distribution channels.
 - Changes in user requirements, creating the need to be increasingly responsive and more efficient.
 - Changes in attitudes toward alternative service delivery mechanisms, creating the need for a full portfolio of service alternatives and products to meet individual user service needs.
 - Changes in the views of service management and third-party maintenance, creating the need to manage service totally and to reduce the focus on specific products or self-manufactured products. In other words, the user's need for total management of service response is recognized.
 - Changes in service needs due to the requirements of integrated, inter-connected office automation systems.

D. TRENDS IN SERVICE TECHNOLOGY

- Increasing emphasis is being placed on more effective management of service on a centralized basis. This has involved the development and implementation of computerized systems for:
 - Service call handling and dispatch. Capabilities are provided for the centralized handling and processing of service calls. Included will be the identification of customers, call-up of information on equipment at

customer site, assignment of service engineer, tracking calls, and call close-out.

- Remote diagnostics/technical assistance. Providing capabilities for screening and processing of service requests to determine problem cause and to attempt a fix in conjunction with user to avoid on-site service. For some classes of equipment - particularly PBX/PABX and integrated workstations, this can also involve remotely diagnosing and repairing equipment via phone line interchange, or at least introducing limited hardware and/or software patches or fixes, until a service engineer can be dispatched.
- Order processing/inventory control. Providing capability for controlling the material/logistics pipeline of whole units, components, parts, materials, and supplies from control warehouses and depots down to and including the field engineer trunk level. Typically, these systems provide for emergency reorder, the maintenance of stock levels to achieve a given fill rate, and tracking of returns.
- Return/rehabilitation control. Systems are now being developed independently, or as an extension of basic inventory control systems, to control the return rehabilitation process in order to control the fill material/logistics pipeline.
- Data management and reporting. Providing capabilities for managing data associated with failure rates, response and repair times, costs, time utilization, etc., by geographic service area, product group, customer class, etc., and providing standard and exception reports. Typically such capabilities include the ability to generate exception or alert reports if service call response and/or repair times exceed certain thresholds.

- Invoicing and billing. Providing capabilities for automatically generating invoices and cost allocations based on completed installation and service calls, and the ability to allocate costs by product, customer class, geographic area, etc.
- Other new systems developments. Work is now being done to develop capabilities for:
 - . Installation planning and scheduling.
 - . Preventative maintenance scheduling.
 - . Scheduling and planning for changes, upgrades, and removals.
 - . Control of service force assets, including vehicles, test equipment, loaners, etc.
- In addition to service management systems developments, major service organizations are developing technology for:
 - Automated or semi-automated board testing.
 - Controlled rehabilitation and rework systems using MRP and scheduling technology.
- Finally, considerable work is being done on the development of product-based modules for direct circuit testing and recovering, enabling modular pull and replacement in case of failure, remote diagnostic interface with central TAC or diagnostic centers via telephone, and built-in backup and recovery hardware and software capabilities via redundant or fault-tolerant circuits or self-diagnostics. These advanced techniques are usually employed in larger office automation systems - PBX/PABX equipment; large, free-standing copiers; and networks for both interactive workstations and word processing systems.

E. BALANCING RELIABILITY, RESPONSIVENESS, AND PRODUCTIVITY GOALS

- To a large extent, most service and product organizations fail to effectively balance reliability, service responsiveness, and productivity goals and objectives. There are a number of reasons:
 1. THE LACK OF AVAILABLE DATA ON EQUIPMENT FAILURE RATES, REPAIR TIMES, ETC.
- Most service organizations do not track or report on such key factors as mean time between failures (MTBF) and mean time to repair (MTTR) by product by cause. In addition, most service organizations do not measure service costs or productivity by product in order to evaluate the effect of alternative reliability levels, the use of built-in test equipment, and design modularity on service repair times and productivity. As a result, even basic information on reliability, maintainability, and repairability is lacking, inaccurate, or not available in a useful form.
- 2. THE LACK OF FORMAL METHODS FOR RELIABILITY, REPAIRABILITY, AND MAINTAINABILITY CONSIDERATIONS IN INITIAL PRODUCT AND ENGINEERING DESIGN STAGES OF THE PRODUCT DEVELOPMENT CYCLE
- Most manufacturing organizations fail to consider the impact of design alternatives on both service productivity and performance, or to bring in service personnel at an early-enough stage in the product design cycle to ensure an effective balance of product reliability and repairability goals.

3. THE LACK OF EFFECTIVE MECHANISMS FOR TRACKING AND REPORTING ON PRODUCT-, SUBSYSTEM-, AND COMPONENT-LEVEL FAILURE AFTER INITIAL PHASE-IN
- This problem of not effectively managing the product from a service standpoint is compounded due to the lack of effective mechanisms for tracking of MTBF/MTTR data for new products, or for evaluating the need for engineering and design modifications of those products that have an unusually high field failure rate.
 - In essence, there is a trade-off to be made for each product - a trade-off that relates product price, product reliability, and service supportability, as shown in Exhibit III-6. For each individual product, there is a cross-over point where it is less expensive, on a per unit basis, to provide after-sales service in order to achieve a given uptime, than it is to add more redundancy to improve inherent reliability and extend the product MTBF.
 - Many large service organizations, particularly in the PBX/PABX, large copier, and integrated workstation field, are establishing product management organizations within the service group to:
 - Track MTBF and MTTR data by product.
 - Manage product service and costs.
 - Provide direct input into new product design decisions in order to support the trade-off analysis.
 - In essence, it is essential to continuously manage product design reliability versus service response and repairability. This requires data on product failure rates by cause and a dedicated and committed product management group.

IV TACTICAL CONCLUSIONS AND RECOMMENDATIONS

IV TACTICAL CONCLUSIONS AND RECOMMENDATIONS

A. GENERAL CONCLUSIONS

- The increasing complexity, proliferation, and integration of office products in overall information systems have made the problems of providing service for office automation equipment more difficult and more challenging. Office automation users are growing more dependent on the equipment and are looking for:
 - More cost-effective and responsive service and support.
 - A single source of maintenance for the array of products installed, especially if the products are integrated into a network and for large users.
 - Improved related support services, including improved documentation and training.
- Associated with these needs is the customer's increasing requirement for improved and controlled hardware and software maintenance response, repair times, and performance. In some product areas (such as PBX, large stand-alone copiers, integrated network-based workstations, and word processors) service organizations have been created and are currently managing the product. However, in other product areas, particularly personal computers,

there has been little recognition of the rapidly emerging service needs of the business/professional user. The general attitude of users toward service elements are shown in Exhibit IV-1.

- Because of the failure of many service organizations to meet user needs, there is a strong interest in the use of third-party maintenance organizations, particularly in the area of personal computers.
- An evaluation by major product area of specific service factor needs and requirements is shown in Exhibit IV-2. The exhibit indicates that almost all office automation users need improved documentation and software and hardware maintenance. Other requirements that must be met include:
 - Faster controlled service response and repair time for both hardware and software maintenance.
 - Better mechanisms for part and supply delivery.
 - A need for hotline and remote technical assistance and diagnostics.
 - Significant improvement in overall service support for workstations.
 - A need for improvement in user and systems training, particularly for word processor systems and products.
- The blurring of the distinction between data processing, office automation, and telecommunications will create more problems and opportunities, particularly in the short run. The deregulated ATTIS and the seven new Regional Bell Operating Companies will now begin to compete in the full office automation market, providing the end user with a new channel for support.
- As office automation equipment becomes more integrated and network related, service management and the ability to provide full service to all components of the network will be increasingly important to the user.

**OVERALL EVALUATION OF USER REQUIREMENTS VERSUS
LEVELS OF SERVICES RECEIVED FOR OFFICE PRODUCTS**
(Percent of Respondents)

SERVICE FACTORS			OVERALL		COPIERS		FACSIMILE		PBX/PABX		PERSONAL COMPUTER		WORD PROCESSORS		WORK STATIONS				
			OVERKILL		SATISFIED		OVERKILL		SATISFIED		OVERKILL		SATISFIED		OVERKILL		SATISFIED		
			OVERKILL	DISSATISFIED	OVERKILL	SATISFIED	OVERKILL	DISSATISFIED	OVERKILL	SATISFIED	OVERKILL	DISSATISFIED	OVERKILL	SATISFIED	OVERKILL	DISSATISFIED	OVERKILL	SATISFIED	
Site Planning	46	42	12	45	55	—	—	19	66	15	73	13	13	54	32	14	41	47	12
Installation/Planning	24	56	20	33	54	13	44	17	24	52	24	58	21	35	51	14	50	29	21
Hardware Maintenance	30	38	32	24	31	45	28	31	41	48	38	23	26	24	36	40	42	23	35
Software Maintenance	35	35	30	—	—	—	—	—	23	32	45	36	18	28	31	41	28	41	31
Relocation	47	33	20	32	52	16	61	24	15	42	39	19	—	52	34	13	38	31	31
Deinstallation	47	33	20	41	41	18	64	18	36	24	40	—	—	44	40	16	8	38	54
Supplies	27	57	16	35	44	21	21	38	44	41	15	39	42	19	34	47	29	57	14
User Documentation	41	18	41	38	31	31	34	25	41	21	45	36	8	31	45	24	25	35	40
Training	12	60	28	35	48	17	34	42	24	38	41	44	28	23	36	41	17	53	30
Consulting Services	27	48	25	32	58	10	35	53	12	41	45	43	19	29	42	29	21	46	33
Add-on Sales	23	52	25	23	55	23	43	33	24	21	48	42	23	34	34	32	41	23	36
Environmental Planning	47	43	10	45	45	10	—	—	30	65	5	73	7	20	44	7	45	50	5

○ = More than 30% of users dissatisfied with service

SPECIFIC TACTICAL ACTIONS REQUIRED BY PRODUCT AREA

PRODUCT AREA	PROBLEM AREAS	RECOMMENDED SHORT-TERM ACTIONS
Copiers	<ul style="list-style-type: none"> ● User Training ● Supplies ● Preventative Maintenance ● Faster, Controlled Dispatch and On-site Response 	<ol style="list-style-type: none"> 1. Establish separate training function. 2. Establish and manage supplies distribution as part of service function.
Facsimile	<ul style="list-style-type: none"> ● User Training ● User Documentation ● Faster Controlled Call Handling, Dispatch, and On-site Response ● Supplies/Spare Parts 	<ol style="list-style-type: none"> 1. Establish separate training function. 2. Develop user documentation manuals – particularly for office/secretarial personnel. 3. Establish and manage supplies/spare parts distribution as part of service function. 4. Implement computerized system to support call handling and dispatch.
PBX/PABX	<ul style="list-style-type: none"> ● User Documentation ● Improved Customer Billing, More Accurate Charges for Service ● Broader Range of Services and Responsiveness 	<ol style="list-style-type: none"> 1. Develop user and systems documentation. 2. Develop CAI-based user manual and training programs. 3. Expand range of services offered, including response/repair times, diagnostics, supplies/parts. 4. Provide accurate method for billing based on on-line call close-out.
Personal Computers	<ul style="list-style-type: none"> ● User Training ● User Documentation ● Improved Software Maintenance ● Improved Hardware Maintenance ● Service Management – Coordinated Control of Service Calls by Manufacturer ● Remote Diagnostics – Technical Assistance Support 	<ol style="list-style-type: none"> 1. Establish formal training and documentation function. 2. Establish nationwide training centers. 3. Provide central or regional call handling and dispatch capability. 4. Provide technical assistance center access via phone call to 800 number for software support and equipment recovery assistance.
Word Processing	<ul style="list-style-type: none"> ● User Training ● User Documentation ● Faster, Controlled Call Handling and Dispatch ● Spare Parts Supply ● Software Updated 	<ol style="list-style-type: none"> 1. Establish formal training and documentation function. 2. Establish central or regional call handling and dispatch system. 3. Establish field logistics support function. 4. Provide standard method for software update release and distribution. 5. Introduce technician hotline.
Work Stations	<ul style="list-style-type: none"> ● Improve Response and Repair Time ● User/Systems and Software Documentation ● Consulting and Technical Assistance in Installation Planning and Use ● Improve Spares/Component Supply 	<ol style="list-style-type: none"> 1. Establish technical consulting support services. 2. Establish documentation function and improve user software documentation. 3. Establish specific service, response, and repair targets and manage calls to targets. 4. Establish separate logistics function as part of service.

- Third-party maintenance firms are entering the office automation market because of the needs expressed above. This will have the effect of increasing the competition associated with service quality and responsiveness. In essence, the user will be presented with many more options with respect to service.

B. CHALLENGES TO FIELD SERVICE MANAGEMENT

- The major challenges facing field service management include:
 1. DEVELOPMENT OF A FULL-SERVICE PORTFOLIO
 - Customers are demanding a greater array of service products. These needs and requirements differ by market segment and product area. This is particularly true in the area of personal computers and PBX/PABX.
 2. DEVELOPMENT OF A STRATEGIC APPROACH TO SERVICE PRICING FOR THE SERVICE PRODUCT PORTFOLIO
 - While customers are increasingly focusing on the cost of service and the full cost of ownership, it is clear that customers are willing to pay more for the services they need. Little attention has been given in the past to service pricing. In most of the product markets, service has been priced based on the industry leader.
 - As a result, IBM in the word processing and workstation market and Xerox in the copier market have served as bases for setting service prices. In the PBX market, because of the regulated nature of telecommunications and the bundling of service prices in product rental/leases, service prices from inter-connect manufacturers or distributors have been based primarily on marginal

costs. The effect of deregulation will be to unbundle service prices. In essence, the development of prices for the service portfolio must be based on a full evaluation of:

- Cost of providing service.
 - Competitive prices.
 - Value in use.
- As indicated above, most service organizations have failed to control (or measure) service costs and very few have attempted to measure customer value in use. Thus service prices have historically been driven by competitive prices.
 - Market studies show, in Exhibit IV-3, that the user does have specific, differing value in use for different classes of service depending upon the market segment and product. This data should be used in developing an efficient service pricing strategy.
3. DEVELOPMENT OF A SERVICE MANAGEMENT CONCEPT OF SERVICE OPERATIONS
- Many customers of office automation products have expressed an interest in the overall management of service for their installed base of office automation products. The development of this concept requires a total, full-service management of the service call and the concurrent development of support systems for call handling and dispatch, technical assistance, and material/logistics inventory and pipeline. Users primarily want on-site service, and while they are willing to support and work with remote diagnostics, they prefer that the service organization provide integrated response where and when needed, as shown in Exhibit IV-4.

EXHIBIT IV-3

VALUE IN USE OF EXTENDED SERVICE

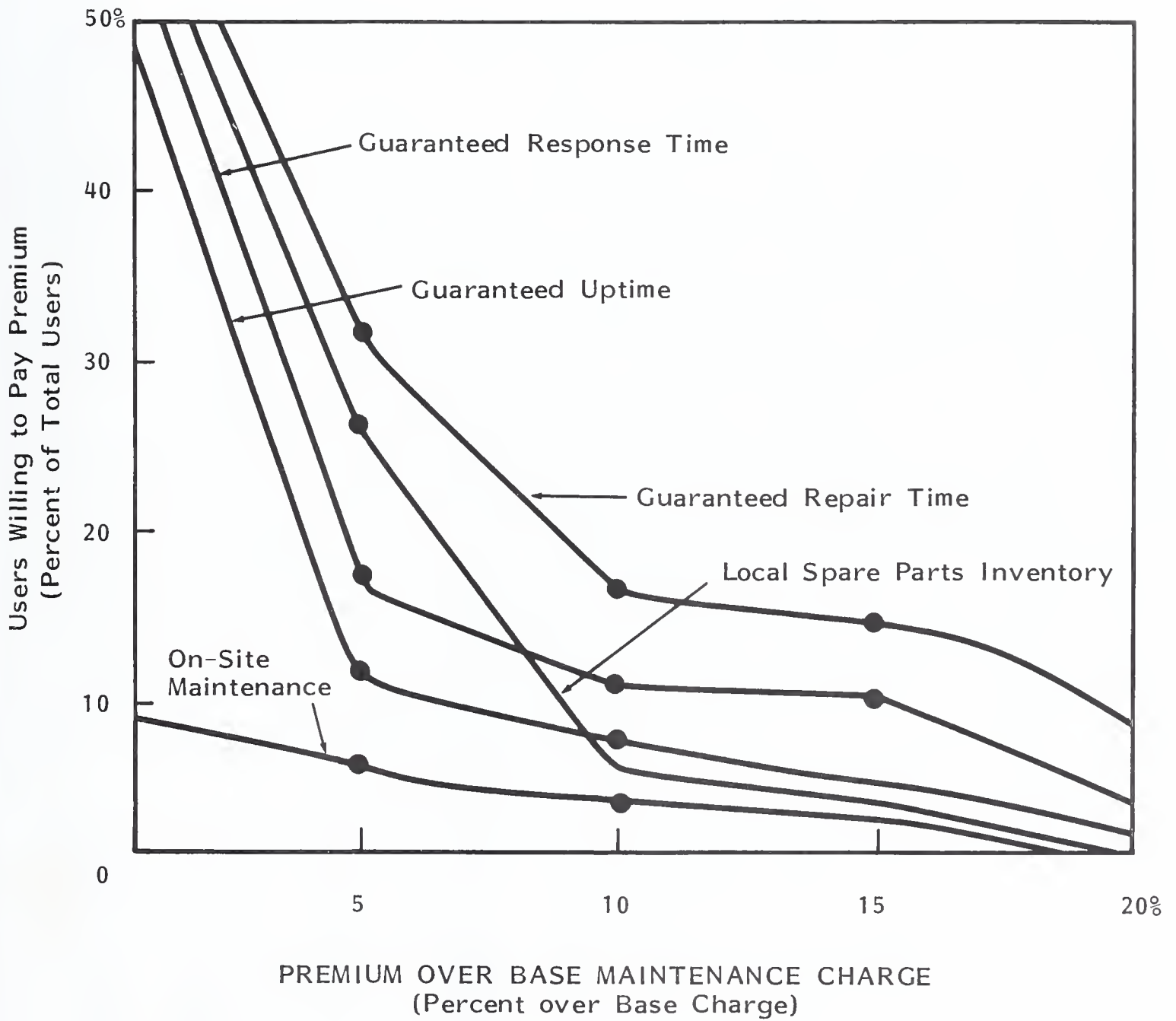


EXHIBIT IV-4

USER ATTITUDES TOWARD ALTERNATIVE DELIVERY MECHANISMS

DELIVERY MECHANISMS	RATING (1-10)													
	Overall		Copiers		Facsimile		PBX/ PABX		Personal Computer		Word Processor		Work Stations	
	Software	Hardware	Software	Hardware	Software	Hardware	Software	Hardware	Software	Hardware	Software	Hardware	Software	Hardware
Traditional On-site Service	8.32	8.24	8.92	N/A	8.69	N/A	8.28	7.28	6.95	6.67	8.83	8.75	8.42	8.42
User Involvement in Diagnosis, Working With Support Center	6.42	6.43	6.11	N/A	5.69	N/A	6.21	5.34	6.57	6.39	6.99	6.91	6.35	6.35
User Replacement of Circuit Boards, Component and Software Patching	4.73	4.91	3.90	N/A	2.97	N/A	5.10	4.37	5.21	5.25	5.29	5.28	4.97	4.97
User Delivering Modules to Repair Center	3.98	4.20	2.43	N/A	3.06	N/A	3.10	3.27	5.36	5.26	4.09	4.11	4.23	4.23
On-site Standby of Service Personnel during Critical Periods	4.02	4.26	3.20	N/A	3.00	N/A	6.76	5.82	2.98	2.95	4.41	4.13	4.55	4.55

4. DEVELOPMENT OF AN APPROACH TO THIRD-PARTY MAINTENANCE

- The rapid increase in third-party maintenance as a viable alternative requires that service organizations either enter the third-party service market independently or as part of a service posture based on improved service quantity and responsiveness and/or price reductions.

C. RECOMMENDED ACTION PLANS TO MEET IMMEDIATE CHALLENGES

- Service management must take a number of steps to meet the immediate challenges identified above. These include the establishment of full service management capabilities, the implementation of service management systems, and the extension of service to product and market areas willing to pay for service, including but not limited to the PC market. A summary list of recommended tactical actions is presented in Exhibit IV-5.

TACTICAL ISSUES AND CONCLUSIONS

KEY TRENDS AND FACTORS	IMMEDIATE CHALLENGES TO FIELD SERVICE ORGANIZATIONS	SHORT-TERM ACTION PLANS 1984-1985
Rapidly growing use of personal computers in business and industry.	Provide integrated responsive nationwide on-site service for PCs on a cost-effective basis.	<ol style="list-style-type: none"> 1. Expand service capability to involve PCs. 2. Introduce full-service portfolio for PC end users willing to pay.
Growing integration of office automation products.	Service full product array without finger pointing.	<ol style="list-style-type: none"> 1. Establish service management capability and function. 2. Expand technical skills and parts availability at field level.
Increasing complexity and sophistication of equipment.	Improve ability to identify problems and provide rapid response.	<ol style="list-style-type: none"> 1. Implement remote diagnostics/technical assistance center hotline.
Deregulation of telecommunications (PBX/PABX) equipment and blurring of functions between DP, office automation, and telecommunications.	Provide cost-effective service in direct competition with new telecommunications vendors (ATTIS, RBOCs, etc.)	<ol style="list-style-type: none"> 1. Recognize impact of deregulation; gain understanding of telecommunications service and support practices. 2. Expand capability to service telecommunications products.
Increasingly tight response and repair time requirements due to growing dependence on equipment by user.	Management control service response and repair by targets in accordance with contractual guarantees and agreements. Avoid "over" or "under" servicing.	<ol style="list-style-type: none"> 1. Implement computerized systems to manage and control: <ul style="list-style-type: none"> ● Call handling and dispatch ● Logistics/supply. Based on management-set targets and objectives.
Wide range of choices due to increasing number of vendors and products.	Provide consulting and technical assistance as part of initial sales/service decision — place increasing emphasis on service quality and responsiveness.	<ol style="list-style-type: none"> 1. Establish technical consulting assistance and installation support planning services. 2. Provide service on a formal basis for a price.
Increasing concern over service containment.	Develop innovative pricing for product portfolio — targeted by market segment.	<ol style="list-style-type: none"> 1. Establish full product/price portfolio. 2. Evaluate current service prices.
Increasing use of local-area networks (LAN) to integrate individual office automation products.	Provide ability to service and support LAN technology as part of product service.	<ol style="list-style-type: none"> 1. Expand technical capabilities to support LAN technology. 2. Offer LAN service and support.
Increasing dissatisfaction with services offered by both OEM vendors and retail distribution channels.	Expand national service and back-up retail/mass merchandise channels to provide integrated service support when required.	<ol style="list-style-type: none"> 1. Offer national call handling and technical assistance support to back up local retailers. 2. Provide full service at a price for those segments requiring service on-site.

V STRATEGIC CONCLUSIONS AND RECOMMENDATIONS

V STRATEGIC CONCLUSIONS AND RECOMMENDATIONS

A. GENERAL CONCLUSIONS

- Significant changes are taking place in the office automation service market as a result of product and technology developments, deregulation, and the growing dependence on office automation equipment as part of day-to-day activities. Users are interested in improved, responsive, and total service to meet their needs.
- The key long-term trends that will affect service include:
 - The full integration of office automation products as part of a full network system.
 - The rapid obsolescence and reduced life cycle of the existing installed base.
 - The growing dependence of the user on the system, placing greater focus on responsive service.
 - The increasing complexity and sophistication of the individual types of equipment and the network that connects them.
 - The deregulation of the telecommunications-related market.

- These trends will create both challenges and opportunities for services management, particularly for those services that are organized as separate profit centers.

B. NEW LONG-RANGE SERVICE OPPORTUNITIES

- Major opportunities created by these trends and changes are summarized in Exhibit V-1. In essence, there are significant long-term opportunities being created in terms of the servicing of obsolete equipment, the ability to provide total service management, and the extension of service products.

C. RECOMMENDATIONS FOR LONG-TERM ACTION

- The major trends and factors lead to both challenges and opportunities, as summarized in Exhibit V-2. Recommended long-term action programs to meet these challenges and opportunities are also shown.
- In developing a long-term strategy to meet field service needs in office automation, it is important to recognize that several major changes are taking place that will affect the customer service/field service organizations of office automation manufacturers and the third-party maintenance organizations that focus on the office automation marketplace. These factors relate to:
 - The significant trend toward integration of individual office automation products through voice/data networks, local-area networks, and extended PBX systems. To a large extent, we will see emerging two classes of office automation users: those with large, integrated networks and those with small, individual standalone office automation units.

EXHIBIT V-1

MAJOR SERVICE OPPORTUNITIES

- Service and Support of Older PBXs and Word Processing Systems
 - Maintenance and Repair
 - Moves and Upgrades
- Service Management of Integrated Office Automation Systems
 - Installation of Multiple-Vendor Equipment
 - Maintenance and Repair of Multiple-Vendor Equipment
 - Moves, Upgrades, and Changes to Systems
- Service and Support of Copying Equipment
 - Control Over Service - Most Copiers Not "Owned" by Anyone
 - Supply of Materials (Paper, Toner, Etc.)
 - Preventative Maintenance
- Service and Support of Local-Area Network (LAN)-Based Integrated Systems
- New Service Products Markets For:
 - Training
 - Documentation
 - Parts and Materials Supply
 - Software

FIGURE V-2

STRATEGIC ISSUES AND CONCLUSIONS

MAJOR TRENDS AND FACTORS	LONG-RANGE CHALLENGES TO FIELD SERVICE MANAGEMENT	STRATEGIC OPPORTUNITIES	RECOMMENDATIONS FOR LONG-TERM ACTION PROGRAM, 1985-1988
Integrated office systems combining data processing, word processing, and telecommunications functions.	<ul style="list-style-type: none"> Establish service as a separate line of business in support of general office automation technology. 	<ul style="list-style-type: none"> Service as a separate revenue and profit-generating line of business. 	<ul style="list-style-type: none"> Establish full profit center service operation with supporting marketing, product and business planning, and financial/accounting functions.
Growing importance of service in purchase decision as products become increasingly commodity-like and life cycles shorten.	<ul style="list-style-type: none"> Develop a full-service organization to produce a full array of "products" for the office environment, including: <ul style="list-style-type: none"> Installation and site planning Installation Hardware maintenance Software maintenance Moves and changes Upgrades/configuration changes Documentation Training Parts/supplies Consulting Other support service 	<ul style="list-style-type: none"> Service management as a framework/concept for managing and delivering support. 	<ul style="list-style-type: none"> Define full-service product portfolio. Expand into third-party maintenance for those products under the service management umbrella.
Need for integrated, single source of service; especially in connection with fully integrated network-based office automation systems.			
Need for a comprehensive portfolio of services to support all aspects of after-sales support, including training.	<ul style="list-style-type: none"> Implement a comprehensive system to manage and control service as a business, including: <ul style="list-style-type: none"> Installation planning and scheduling Call handling and dispatch Preventive maintenance scheduling Technical assistance/remote diagnostics Order processing and inventory control Data base management Reporting Invoicing & cost accounting 	<ul style="list-style-type: none"> Management and control of service delivery, responsiveness, and quality to meet customer needs at a profit. Increase profit margins and return on investment from service-based activities. 	<ul style="list-style-type: none"> Collect and allocate data on costs and revenues from individual products as a basis for service pricing. Implement remote diagnostics and technical assistance centers accessible via a national 800 number. Measure customer needs, requirements, and performance on a continuing basis. Develop accurate data on MTBF and MTTR as a basis for new product planning. Implement integrated system for service management control with common data base.
Need for establishment of a strategic pricing approach by market segment.	<ul style="list-style-type: none"> Provide service portfolio customized to meet needs of individual market segments and niches. Base pricing on evaluated combination of cost, competition, and value in use. 		

- The growing importance of improved service response and repair (to ensure that office automation products are available when and where required). Greater emphasis is placed on the need for service management and provision of a totally integrated service support effort after initial sale.
- Increasing customer interest and focus on cost containment and the provision of quality service that is guaranteed to be reliable and responsive.
- These trends all point toward the need for a comprehensive, integrated strategy that provides for the management of the service function from point of sale to full after-sale support, including all the associated products, such as:
 - Site and installation planning.
 - Installation.
 - Hardware maintenance.
 - Software maintenance.
 - Documentation.
 - Training.
 - Supply and parts sales.
 - Moves and changes.
 - Upgrades.

- Environmental and operational audit.
 - Consulting and support services.
 - Deinstallation/removal.
- In essence, the user will look toward the service organization for the full array of post-sales needs. Larger organizations and users with a full array of products on an integrated systemic basis have a growing interest in those service organizations that can provide a total service management approach and can offer the ability to control and manage this service on a regional and nationwide basis, with a full commitment to response time, repair time, and the provision of service quality and after-sales support.
 - It would also be necessary for those service organizations wishing to participate significantly in the service and support of office automation products to establish integrated computerized systems to manage and control full service/processing, including call handling and dispatch, remote diagnostics and technical assistance, management of the data base relating to customer installed base and configuration, and management and control of the logistics pipeline.
 - Finally, the service organization must develop a comprehensive strategic portfolio of service products and develop a service pricing approach strategy that is responsive to both the cost containment interests of certain market segments and to the need for highly responsive and quality service for other market segments.
 - The size and growth of the office automation market and the need for integrated service will tend, in the long run, to create significant economies of scale and efficiencies in large nationwide service organizations servicing an extensive installed base.

- For those organizations with large service functions and a developed service management infrastructure, basic prices for after-sales service and installation, maintenance, and repair will drop. These organizations are currently providing installation service at approximately 15-30% of acquisition price, and after-sales maintenance at approximately 8-14% of acquisition price annually. On the other hand, premium prices from the standard service base will increase to provide a closer correlation between the value-in-use needs of the market segments requiring specialized or highly responsive service, versus those market segments that are more interested in cost containment.
- This will place the smaller service organizations attempting to provide national service for installed-base office automation products at a competitive disadvantage. It will undoubtedly also force less efficient service organizations to adopt one of two strategies: either grow by entering the third-party maintenance market or be divested and acquired by other service organizations that can offer the smaller manufacturer quality service at an economical price. In essence, except for highly selective product areas, most of the office automation products in the future will be serviced by large nationwide service organizations on either a direct or third-party maintenance basis.
- In summary, the primary strategic challenge to the service managers in the office automation market is to achieve economic and controlled growth through the introduction of integrated service products and the implementation of effective advanced management systems to manage and control the full-service process and to maintain tight controls on costs, levels of responsiveness, and service productivity. It will also be critical to introduce market-segment-oriented, value-in-use pricing to enable appropriate revenue, return on investment, and operating margins.
- For large users of integrated office systems, third-party maintenance organizations will offer an attractive alternative, particularly for those national third-party service organizations that have established integrated systems to manage and control service dispatch and hotline support for the typical array of office automation products.

APPENDIX A: LOCAL-AREA NETWORK
MAINTENANCE ISSUES

APPENDIX A: LOCAL-AREA NETWORK MAINTENANCE ISSUES

A. INTRODUCTION

- Local-Area Networks (LANs) provide a method of transmitting information from one point to another within a limited distance, thus allowing shared resources from desk to desk, office to office, and building to building.
- The dramatic growth of microprocessor technology has spurred the use of LANs in conjunction with current office products such as PBXs, personal computers, and word processors, as shown in Exhibit VII-1. This growth can be attributed to the cost savings of sharing information processing and data storage resources.
- Currently, due to the lack of standardization of LAN architecture and protocol, compatibility of equipment is an important issue.
- In addition, there is a significant lack of coordination in the areas of planning and implementation as a result of the number of user-planned and user-installed systems.
- As use of and reliance on LANs increase, these issues must be addressed by office product vendors.

B. USE OF LOCAL-AREA NETWORKS

- The dramatic growth in LANs is readily apparent, as shown in Exhibit VII-1. Users of PBX (PABX) systems, personal computers and word processors were queried concerning their current use of LANs, as shown in Exhibit VII-2.
 - Of all three product types, word processor users use LANs the most (29%). Seventeen percent of the PBX users and 10% of the personal computer users indicated that they use LANs.
 - A surprisingly large number of PBX users did not know if they were currently using a LAN with their system.

C. CONFIGURATION OF LOCAL-AREA NETWORKS

- Users were asked which type of configuration their LAN was. The three commonly used ones are as follows:
 - Star configurations use a central controller connected to each device by cable. The advantage of a star configuration is the simplicity of monitoring and controlling data flow. The disadvantages include high initial cost and the decreased reliability caused by a single point of breakdown. Exhibit VII-3 demonstrates a typical star configuration.
 - A ring configuration connects devices by one or more cables in a ring or circular pattern. Since data can flow either direction in the ring, a breakdown of any single device does not affect the entire network. Exhibit VII-4 depicts a typical ring configuration.

- A bus configuration is comprised of an open-ended transmission line where devices are connected to the cable by taps, allowing data to also flow both directions from any device. Since the configuration is an open-ended line, it is very easy to add new devices. Also, as in ring-configured networks, a single device failure does not affect other devices in the network. Exhibit VII-5 depicts a typical bus configuration.
- Exhibit VII-6 shows which configurations are used by each product type.

D. FACTORS IN LOCAL-AREA NETWORK MAINTENANCE

- Since users initially turn to networking as a way of increasing resources while reducing overall processing and data storage costs, LAN users will undoubtedly be very price conscious about maintenance.
- In addition, LANs will become increasingly integrated into users' information-system structures. This ever-increasing use will cause a burgeoning demand for LAN maintenance. Since users have already expressed a desire for a single source of maintenance, vendors will need to address the issue of providing service on competitive products.
 - The absence of a single source of maintenance has in the past influenced users to provide their own network maintenance. A maintenance management contract would be an ideal solution to this, since vendors would be able to coordinate and control the maintenance of the entire system without additional training of their FEs on competitive products.
 - Another possibility is to combine test equipment with existing computer equipment within the network, which would monitor and diagnose faults within the system.

- Vendors should consider network maintenance a growing market in which many revenue opportunities can be realized.

APPENDIX B: QUESTIONNAIRE

A. General Management

1. Which of the following services do you currently offer or plan to offer by 1985?

DIRECT SERVICE OFFERED	1983	BY 1985
a) Third-party maintenance	<input type="text"/>	<input type="text"/>
b) Facility maintenance management	<input type="text"/>	<input type="text"/>
c) Guaranteed availability (uptime)	<input type="text"/>	<input type="text"/>
d) Guaranteed response time	<input type="text"/>	<input type="text"/>
e) Guaranteed repair time (hardware)	<input type="text"/>	<input type="text"/>
f) On-site standby	<input type="text"/>	<input type="text"/>
g) Variable shift coverage (versus fixed schedules)	<input type="text"/>	<input type="text"/>
h) On-site spares	<input type="text"/>	<input type="text"/>
i) Guaranteed turnaround on software repairs	<input type="text"/>	<input type="text"/>
j) Remote diagnostics	<input type="text"/>	<input type="text"/>
k) Preventive maintenance and field changes during nonprime hours	<input type="text"/>	<input type="text"/>
l) System software maintenance	<input type="text"/>	<input type="text"/>
m) Application software maintenance	<input type="text"/>	<input type="text"/>
n) Depot maintenance (pickup)	<input type="text"/>	<input type="text"/>
o) Depot maintenance (carry/mail)	<input type="text"/>	<input type="text"/>
p) Local area network maintenance	<input type="text"/>	<input type="text"/>

2. Which of these secondary services do you offer or plan to offer by 1985?

ANCILLARY SERVICES OFFERED	1983	BY 1985
a) Environmental planning	_____	_____
b) Physical site planning (layouts)	_____	_____
c) Consulting services (hardware)	_____	_____
d) Consulting services (software)	_____	_____
e) Customer training	_____	_____
f) Installation management and coordination	_____	_____
g) Supplies sales	_____	_____
h) Add-on sales (additional equipment)	_____	_____
i) Upgrade sales (new equipment or features)	_____	_____
j) Site audits	_____	_____
k) Facility relocation	_____	_____
l) De-installation	_____	_____
m) Software sales	_____	_____

B. Field Support/Product Support

1. Please rate the influence of your field service management in the following activities. (Scale of 1-10: 10 = excellent, 5 = average, 1 = very poor.)

ACTIVITIES	RATING (1-10)	
	1983	1985
a) Product specification	_____	_____
b) Product design	_____	_____
c) Serviceability design	_____	_____
d) Documentation	_____	_____
e) Diagnostic development	_____	_____
f) Selection of test equipment	_____	_____
g) Spares requirements	_____	_____
h) Geographic control of sales	_____	_____
i) Exceptions to standard maintenance agreements	_____	_____
j) Product performance objectives	_____	_____
k) Quality control in manufacturing	_____	_____
l) OEM acceptance criteria	_____	_____
m) Customer education	_____	_____

2. To what extent has software support been integrated into hardware support structure? By 1985?

SOFTWARE SUPPORT ACTIVITY	1983	1985
a) System Control Software	_____ %	_____ %
b) Application Software	_____	_____
c) Maintenance of Third-party software	_____	_____

3. On a scale of 1-10 (10 = high) how important is it to you to offer the following types of services:

1-10

a) Field support via remote diagnostics

b) Field support via user self-diagnostics

c) Telephone field support

d) On-site field support

4. What are your objectives and what did you achieve in these following measures of product performance; (break down by type of product e.g., mainframe, mini etc.)

PRODUCT TYPE	MEAN TIME TO REPAIR (hours)		MEAN TIME BETWEEN FAILURES (hours)		AVERAGE AVAILABILITY (percent)		MEAN TIME TO RESPOND (hours)	
	OBJ.	ACT.	OBJ.	ACT.	OBJ.	ACT.	OBJ.	ACT.
a) <div></div>								
b) <div></div>								
c) <div></div>								
d) <div></div>								
e) <div></div>								

5. Do you currently offer or do you plan to offer any of the following services?

	CURRENTLY IMPLEMENTED? YES/NO	IMPLEMENTED BY 1985? YES/NO
a) Remote diagnostics	_____	_____
b) Centralized dispatching	_____	_____
c) Modular, plug-in units for user to deliver to repair centers	_____	_____
d) Real-time incident reporting	_____	_____
e) Real-time IR (parts usage included)	_____	_____
f) Regional repair centers	_____	_____
g) Third-party repair centers	_____	_____
h) Third-party on-site maintenance	_____	_____

6. a) What do you see as the trend in capital investment in spare parts inventories?

YEAR OF MEASUREMENT	PERCENT OF GROSS SERVICE REVENUES FOR YEAR
1983 (most recent inventory)	_____ %
1985 (projected)	_____ %

b) Why, or could you comment on this trend?

Comment: _____

7. a) Have you announced or have you set a policy on the maintenance and support of local area networks serving competitive products? Yes/No_____

b) Comment:

C. Personnel

1. Please identify your sources of new employees and rate them on a scale of 1-10. (1 = little or no importance, 10 = highest importance.)

SOURCE OF NEW EMPLOYEES	RATING (1-10)	
	1983	1985
a) Competition	_____	_____
b) Trade schools	_____	_____
c) Military schools	_____	_____
d) Two-year college programs	_____	_____
e) Four-year colleges	_____	_____
f) Apprenticeship programs	_____	_____
g) Other division in company	_____	_____
h) Employee referrals	_____	_____
i) Other:	_____	_____

2. Do you provide in-company formal training? If so, in what areas?

	YES/NO
a) Indoctrination	_____
b) Basic training (apprentice level)	_____
c) Product (technical)	_____
d) Systems software (system)	_____
e) Applications software	_____
f) Management development	_____
g) Technological upgrading	_____
h) Other	_____

3. Do you (F) fully or (P) partially reimburse or otherwise provide financial support for:

	F/P
a) Education/training	_____
b) Relocation	_____
c) Company products/stocks	_____
d) Professional associations/memberships/journals	_____
e) Other _____	_____

4. Which personnel policies do you think have a significant impact on the satisfaction level of your employees?

FRINGE BENEFITS	1983	BY 1985
a) Life insurance	_____	_____
b) Hospitalization	_____	_____
c) Major medical (80% or better)	_____	_____
d) Limited medical (out patient)	_____	_____
e) Dental	_____	_____
f) Eyesight/glasses	_____	_____
g) Retirement	_____	_____
h) Disability insurance	_____	_____
i) Matched savings	_____	_____
j) Profit-sharing	_____	_____
k) Paid sick leave	_____	_____
l) Grievance procedures	_____	_____
m) Improvement programs for marginal performers	_____	_____
n) Exit interviews	_____	_____
o) Appraisal and counseling	_____	_____
p) Career path definitions	_____	_____
q) Pay for performance guidelines	_____	_____

5. What incentives are offered to field service employees?

INCENTIVES	MANAGEMENT		EXEMPT		NONEXEMPT	
	1983	BY 1985	1983	BY 1985	1983	BY 1985
a) Stock options	_____	_____	_____	_____	_____	_____
b) Performance bonuses	_____	_____	_____	_____	_____	_____
c) Suggestion awards	_____	_____	_____	_____	_____	_____
d) Periodic recognition awards ("FE of the quarter," etc.)	_____	_____	_____	_____	_____	_____
e) Special projects, foreign assignments, etc.	_____	_____	_____	_____	_____	_____
f) Award conferences, trips	_____	_____	_____	_____	_____	_____
g) Competitive scholarships for employees or family	_____	_____	_____	_____	_____	_____
h) Other: _____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____
_____	_____	_____	_____	_____	_____	_____

6. a) How many direct labor field service personnel were hired in:

1983 _____ (forecast)

1985 _____ (forecast)

b) How many direct-labor field service personnel will leave your company in:

1983 _____ (forecast)

1985 _____ (forecast)

c) What are the major reasons for persons leaving your department or company?

	1983
i) Voluntary, no reason given	_____
ii) Left for higher salary, better total compensation	_____
iii) Released for company reasons	_____
iv) Promotion in another company	_____
v) Relocation by another company	_____
vi) Promoted within own company	_____
vii) Transferred to foreign subsidiary or other division	_____
viii) Other _____	_____
Total	_____

d) What are your present and future staffing levels in the following areas?

U.S. EMPLOYEES	1983	1984
i) Total employees in company	_____	_____
ii) Total in field service division	_____	_____
iii) Number of direct-labor FEs	_____	_____
iv) Number of field support engineers	_____	_____
v) Number of field supervisors	_____	_____
vi) Number of managers in field	_____	_____
vii) Line managers at headquarters	_____	_____
viii) FE staff managers (total)	_____	_____
ix) FE staff personnel (nonmanagement including administration)	_____	_____

7. 1983 annual salaries, office system field engineers (front-line product field service technicians)

JOB DESCRIPTION	TITLE	RANGE		AVERAGE PAID (actual)	AVERAGE GAIN OVER 1982 (percent)
		MAXIMUM	MINIMUM		
a) Entry-level trainee maintenance	Trainee				%
b) Qualified field service technician carries territory, requires occasional assistance, renders some aid to lower levels	Qualified Field Engineer				%
c) Senior-level field service technician: Generally gives more assistance than received, assigned field training duties to assist in development of first two categories	Senior Field Engineer				%
d) Qualified field service engineer in software support	Software Support Engineer				%
e) _____	Supervisor				%
f) _____	Line Manager				%

D. Financial/Administrative Operations

1. How do you measure changes in field service productivity?

MEASUREMENT METHOD:	YES/NO
a) Ratio of gross revenue carried per field service person	_____
b) Ratio of personnel to equipment by category	_____
c) Ratio of personnel to management	_____
d) Net ratio of expenses to revenue after cost of improvement	_____
e) Other _____	_____
_____	_____
_____	_____

2. Have you experienced productivity improvement in servicing in the following areas?

IMPROVEMENT	YES/NO	PRODUCTIVITY IMPROVEMENT (percent)
a) Remote diagnostics	_____	_____
b) Repair centers	_____	_____
c) Regional parts depots	_____	_____
d) Centralized dispatch	_____	_____
e) Support centers	_____	_____
f) Field education	_____	_____
g) Cross training	_____	_____
h) Multiple territory assignments	_____	_____
i) Other _____	_____	_____
_____	_____	_____
_____	_____	_____

3. Please indicate the percentage of total operating revenues credited to the field service division coming from the following categories. (If fiscal is different from calendar, please supply FY dates.)

SOURCE OF REVENUE CREDITS	PERCENT OF TOTAL REVENUE	
	1983	1985
a) Warranty	_____	_____
b) Third-party contracts	_____	_____
c) Installation charges	_____	_____
d) De-installation charges	_____	_____
e) Consulting	_____	_____
f) Parts sales	_____	_____
g) Supplies sales	_____	_____
h) Sales of ancillary equipment	_____	_____
i) Sales of software products	_____	_____
j) Maintenance of software products	_____	_____
k) Sales discounts on maintenance	_____	_____
l) Other _____	_____	_____
m) Other _____	_____	_____

4. Please indicate the percentage of total field service division expenses in the following categories (and supply FY dates if different from calendar year).

EXPENSE LINE ITEM	PERCENT OF TOTAL EXPENSES [use () to indicate credit]	
	1983	1985
a) Direct labor	_____	_____
b) Management and administrative	_____	_____
c) Benefits	_____	_____
d) Parts	_____	_____
e) Depreciation	_____	_____
f) Travel	_____	_____
g) Education	_____	_____
h) Logistics, repair depot, and other expenses not reported above	_____	_____
i) Overhead	_____	_____
j) Other significant categories	_____	_____

5. What was your overall financial performance in the following field service categories?

FINANCIAL PERFORMANCE	FISCAL YEAR END _____	
	1983	1985
a) Field service revenue (\$ millions)	_____	_____
b) Field service expenses (\$ millions)	_____	_____
c) Pretax profit (percent)	_____	_____
d) Revenue per field service engineer (direct labor)	_____	_____
e) Direct expense per field service engineer (direct labor)	_____	_____
f) Fully burdened expense per field service engineer (direct labor)	_____	_____

6. a) Please describe the methodology your company uses to set maintenance prices (percent of purchase tested against cost of service projection, etc.):

- b) At what ratio of basic maintenance price to list price do you believe that:

i) Users will actively consider alternative sources	_____ %
ii) Users will definitely contract third party or maintain own equipment	_____ %
iii) Users will refuse to buy the original product, given the option	_____ %

- c) How frequently do you expect to change prices of maintenance:

Comments: _____

- d) Do you offer discounts for:

	PERCENT DISCOUNT
i) User assistance in remote diagnostics	_____ %
ii) User replacement of plug-in modules or units	_____ %
iii) User delivery of plug-in modules or units to repair center	_____ %
iv) Relaxed requirement on response time	_____ %
v) User purchase of spare parts kits	_____ %
vi) Other: _____	_____ %

7. a) Are your maintenance contracts: (i) automatically renewed _____ or (ii) negotiated each renewal cycle? _____
- b) What is the length of your normal contract? _____ (months)
- c) Do you normally invoice (i) monthly _____, (ii) quarterly _____, (iii) semiannually _____, (iv) annually _____, (v) other _____.
8. a) Has your field service division implemented a field quality assurance program or other formal operational audit? Yes/No
- b) Comment: _____

9. What is the average cost breakdown of a typical fault call? (Please respond for products your company services.)

PRODUCT SERVICED	TOTAL COST (dollars)	DIRECT LABOR (percent)	TRAVEL (percent)	PARTS (percent)	OVERHEAD & SUPPORT
Large mainframes	_____	_____	_____	_____	_____
Medium mainframes	_____	_____	_____	_____	_____
Small systems	_____	_____	_____	_____	_____
Peripherals	_____	_____	_____	_____	_____
Terminals	_____	_____	_____	_____	_____
Word processors	_____	_____	_____	_____	_____
Personal computers	_____	_____	_____	_____	_____
Copiers, facsimile	_____	_____	_____	_____	_____
Work stations	_____	_____	_____	_____	_____
PABX, PBX	_____	_____	_____	_____	_____
Teleprocessing/communications	_____	_____	_____	_____	_____

